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NORTH AMERICAN FAUNA
No. 33

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A BIOLOGICAL SURVEY OF COLORADO

BY

MERRITT CARY
ASSISTANT BIOLOGIST, BIOLOGICAL SURVEY

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Biological Survey,
Washington, D. C., February 21, 1911.

Sir: I have the honor to transmit herewith for publication as North American Fauna No. 33 a report on the results of a biological survey of Colorado, by Merritt Cary. The report consists of three sections. The first characterizes the five life zones which traverse the State, defines their extent and limits, and discusses their agricultural and economic possibilities. The second consists of a complete list of the mammals of Colorado with brief notes on their habits, distribution, and economic relations. The third is a list of the principal trees and shrubs of Colorado observed by the assistants of the Biological Survey during the progress of work in the State, with annotations as to their distribution and abundance.

Respectfully,

Henry W. Henshaw,
Chief, Biological Survey.

Hon. James Wilson,
Secretary of Agriculture.

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No. 33. NORTH AMERICAN FAUNA. August, 1911.

A BIOLOGICAL SURVEY OF COLORADO.

By Merritt Cary.

INTRODUCTION.

Colorado, because of its diverse and striking physical features, presents an interesting field for natural-history investigations, and has received more than ordinary attention from naturalists. Nevertheless, prior to 1905 the distribution of mammals and birds had been studied in detail over only a few small areas, chiefly on the eastern slope of the main ranges, on the adjacent plains, and in the southern end of the San Luis Valley. Field work in the more accessible parts of the State by several field naturalists of the Biological Survey had accumulated important series of specimens and valuable data on the fauna and flora. Many perplexing problems of geographical and vertical distribution and relationships of species, however, remained to be solved. Moreover, the intimate connection and correlation between the natural life zones and crop zones of the country, as pointed out by Dr. Merriam,[1] made increasingly apparent the lack of information respecting Colorado. The data on the distribution of species in Colorado available at the beginning of 1905 proved entirely inadequate for a detailed study of the life zones, although the need of accurate delimitation of the zones constantly increases as vast areas are opened to agriculture and horticulture through modern methods of conserving and distributing the water supply.

Accordingly, in 1905, the writer was directed to undertake a biological reconnoissance of certain of the least-known sections of northern Colorado with a view to the completion of a detailed survey of the State. Field operations were begun early in June of that year. Preliminary work in the mountains of Boulder, Jefferson, and Clear Creek Counties was followed by a wagon trip from Boulder across the range to Middle Park by way of Rollins Pass; north over the western end of the Rabbit Ear Mountains into North Park; thence west to Steamboat Springs, crossing the Park Range over Buffalo Pass, and down the Bear River Valley as far as Axial Basin. Traveling southward over the Danforth Hills to Meeker and across the White River Plateau, the expedition finished its season's work in the Grand River Valley.

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[1] Life Zones and Crop Zones of the United States, by C. Hart Merriam, Bull. 10, Biological Survey, U. S. Dept. Agric., 1898.

Field work was continued in northern Colorado in 1906. Again outfitting at Boulder, I made a wagon trip of much greater length, completely encircling the area covered in 1905.[1] The route was along the northern and western boundaries of the State, from Boulder north to Fort Collins; west over the Medicine Bow Range to North Park; across the northern end of the Park Range to Hahns Peak and Slater; down the Snake River Valley to the Escalante Hills and northwest to Browns Park, on Green River; thence south to Rangely, on White River, and over the Book Cliffs to Mack, in the Grand River Valley; northeast in the valleys of Grand and Eagle Rivers to Wolcott; north to Egeria Park; east across the Gore Range to Middle Park; and back to Boulder by way of Berthoud Pass and Black Hawk.

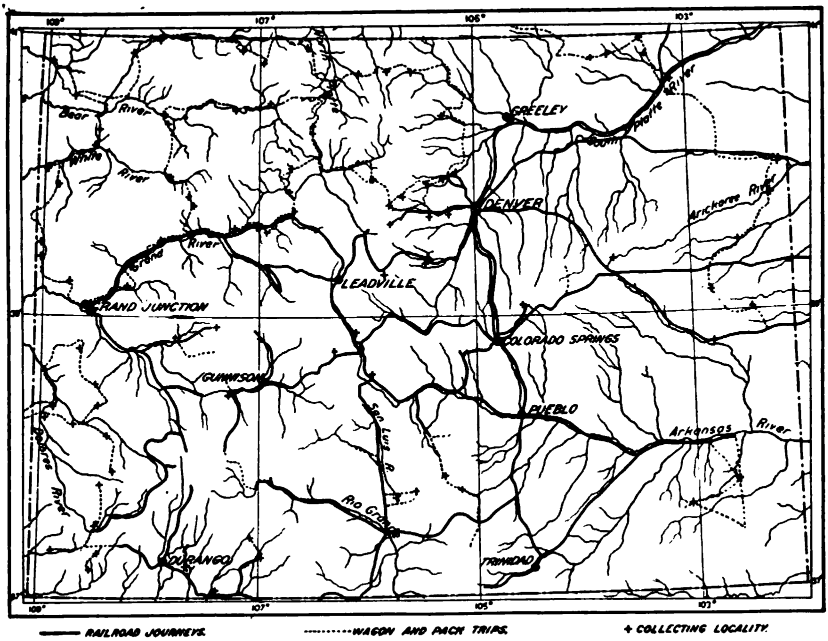

FIG. 1.—Map of Colorado showing routes and collecting localities of Merritt Cary, 1905, 1906, 1907, and 1909.

The field season of 1907 was devoted to a detailed study of zonal conditions in all the important physiographic areas of southern Colorado, including a trip into the little known La Sal Mountains along the boundary of eastern Utah. Owing to the extent of territory covered, the railroads were largely utilized for travel, but many side trips were made by stage and pack train.

---

[1] The ready resource of my camp assistant, Mr. Walter Blanchard, of Boulder, contributed greatly to the success of the wagon trips of both 1905 and 1906. Over much of the region traveling was arduous and on some of the high mountain passes even dangerous.

Knowledge was still lacking as to the distribution of a great many plains species along the eastern edge of the State, and further work in that region was deemed necessary. Consequently part of the field season of 1909 was spent on the Arkansas Divide and on the plains from Cheyenne Wells northwest to Sterling, Colorado, and Cheyenne, Wyoming. This trip, although of short duration, filled in an important gap and yielded valuable distribution data.

In studying the life zones of Colorado it has been necessary to collect many mammals, birds, reptiles, and plants, illustrating climatic variation, and to work out in detail the geographic and vertical distribution of all characteristic zone species. In regions devoted to agriculture and stock raising, the economic relations of both mammals and birds have been carefully investigated. Valuable information bearing on the past and present ranges and abundance of the larger game mammals and carnivores has been acquired from hunters, trappers, and sportsmen of wide experience in the State.

The present report is based chiefly on the field work prosecuted during 1905, 1906, 1907, and 1909. It is primarily a characterization of the several major distribution areas or life zones, and their geographical and vertical boundaries as here defined are believed to be approximately correct and in sufficient detail for all practical purposes. (See frontispiece.) In the course of three seasons' work it is obviously impossible to run continuous zone lines in a rough and broken region like the mountainous two-thirds of Colorado. To insure reasonable accuracy the zone limits have been checked up both horizontally and vertically by crossing the important mountain ranges, plateaus, and mesas at different latitudes; while abnormal variations of zone level resulting from peculiar physiographic conditions have received special attention.

The report on life zones is supplemented by a chapter on the distribution of trees and shrubs. Many notes on birds and reptiles are incorporated in the sections of life zones to which the different species belong.

The list of Colorado mammals, in addition to the results of the four seasons' investigations conducted by the writer, contains a large amount of important unpublished data collected prior to 1905 by the following naturalists of the Biological Survey: Vernon Bailey, Dr. A. K. Fisher, Edward A. Preble, Arthur H. Howell, J. Alden Loring, and Clark P. Streator. Among the local naturalists whose work has contributed materially to the completeness of the mammal report should be mentioned E. R. Warren, of Colorado Springs, the author of important publications on the mammals of Colorado.

New species of mammals have been described from time to time from the material collected by the Biological Survey in Colorado. Among the mammals collected in southern Colorado in 1907 were three new forms. Owing to unavoidable delay in the publication of the present report, these have been characterized by Dr. Merriam in the Proceedings of the Biological Society of Washington as follows: *Eutamias minimus caryi*, *Neotoma albigula warreni*, and *Thomomys talpoides agrestis*.[1]

In preparing the mammal report I have freely used the collection of the Biological Survey and the private collection of Dr. C. Hart Merriam, both in the United States National Museum. I am indebted to Gerrit S. Miller, jr., curator of mammals in the National Museum, for access to the collections under his charge. Dr. Leonhard Stejneger, of the same institution, has identified the reptiles and batrachians. Dr. J. N. Rose and his assistants have named many of the plants.

EFFECT OF PHYSIOGRAPHIC AND CLIMATIC FEATURES OF COLORADO ON FAUNAL AND FLORAL DISTRIBUTION.

Colorado is no exception to the rule that a region of varied climatic and physiographic conditions possesses a correspondingly large and varied fauna and flora. That it is surpassed by a few other States in the variety of its animal and plant life is due, not so much to a lack of varied physical conditions as to the absence of climatic extremes. The comparatively rich fauna and flora of the State are largely due to the great range of altitude in the mountains, since the high basal plane lies entirely within the arid region. Colorado has neither the extent of latitude nor the low, hot areas of great humidity or aridity which contribute to the wonderfully rich fauna and flora of such States as California and Texas. The extensive eastern plains, the Rocky Mountain system traversing the central part, and the rough region of alternating plateaus, desert valleys, and mesas on the western slope, divide the State into three general topographic regions, each occupying approximately a third of its total area. Dissimilar physical and climatic conditions still further divide these into smaller irregular areas which differ considerably in their fauna and flora. Thus, on the western slope, high mesas, clad with a scrubby and more or less scattering forest growth receiving moderate rainfall, alternate with lower arid desert stretches (some with less than 10 inches of annual rainfall), while in the mountains are extensive belts of heavy forest with much greater humidity (20 to 25 inches annual rainfall) and bare alpine crests and summits above timberline having a truly arctic climate.

East of the mountains are found the fauna and flora peculiar to the Great Plains region, with a slight admixture of Mississippi Valley species in the river valleys along the eastern boundary of the State.

---

[1] Proc. Biol. Soc. Wash., XXI, pp. 143-144, June 9, 1908.

The lower elevations on the western slope have a strong infusion of desert species, characteristic of the Great Basin region. The Rocky Mountain system has a complex fauna and flora—the foothills, the open valleys and parks, the dense forests of the central slopes, and the alpine summits, all having associations of mammals, birds, and plants, which are more or less distinctive.

Altitudinal variation in Colorado has a pronounced effect upon both temperature and moisture, and accounts for great extremes in summer and winter temperatures in different sections, and also for a wide range between night and day temperatures throughout the year. At Grand Junction (4,500 feet) the winter and summer mean temperatures are 29° and 75° F.; at Gunnison (7,600 feet) they are 11° and 59°; at Breckenridge (9,500 feet) they are 16° and 52°; while along the summits of the main mountain ranges the temperatures are still lower.

As temperature is a very important factor in the distribution of life, Colorado is an exceptionally favorable field for illustrating vertical distribution. In fact, the wide range of elevation, from 3,000 and 4,000 feet along the eastern boundary to considerably over 14,000 feet on the summits of the main ranges, furnishes favorable conditions for characteristic species of five of the seven major life zones of North America. Thus, in passing from the plains of eastern Colorado to the summit of either the Front or Sangre de Cristo Ranges, or from the warm desert valleys or sage plains of the western counties eastward to the crest of the Continental Divide, the following life zones are successively traversed: (1) Upper Sonoran, which includes all the basal plane of the State from which the mountains rise; (2) Transition or yellow-pine zone, occupying the foothill region; (3) Canadian, or zone of coniferous boreal forests, comprising the lodgepole pine, aspen, fir, and spruce belts of the middle mountain slopes; (4) Hudsonian, or belt of dwarfed conifers, extending to timberline; and (5) Arctic-Alpine zone, reaching from timberline to the summits of the highest mountain peaks. With the exception of the first named, all are included in full width, and the lower border of the Upper Sonoran zone is nearly reached in some of the low desert valleys of the southwest. Of the above zones the Upper Sonoran and Transition alone are of agricultural importance. Their adaptation to various crops is discussed under their respective headings.

The Austral element (Upper Sonoran zone) occupies territory aggregating nearly half the area of the State, or about twice as much as the Boreal element (including Canadian, Hudsonian, and Arctic-Alpine zones). The region of overlapping austral and boreal species (Transition zone) is about equal in extent to that occupied by the boreal zones.

On the eastern slope of the front ranges, as a result of the relatively abrupt ascent from the base level of the plains, the several life zones are usually restricted to horizontally narrow and well-defined belts. West of the Continental Divide, however, they often cover broad and extensive areas, as the incline of the country is more gradual. There is, moreover, in consequence, a decided overlapping of species for a considerable horizontal distance, rendering the zonal limits less clearly defined than on the steeper slopes. The boundaries of the zones in western Colorado are extremely irregular and sinuous, owing to the broken and diversified character of the country, and especially to the warm desert valleys which enter the State from the west and deeply penetrate and parallel the westward extending boreal plateaus and mountains.

The vertical breadth of the zones is much the same on both sides of the Continental Divide. The zone levels, however, are a few hundred feet higher on the warmer western slope, particularly in northern Colorado. In southern Colorado the combined effects of lower latitude and more elevated base level are noticeable in higher zone levels, which are about the same on both sides of the Continental Divide.

The vertical boundaries assigned the several zones are necessarily approximate, since various governing factors, chief among which are slope exposure, steepness of slope, and deforestation, either force species above their normal limits or restrict their limits below normal. On the border of each zone is a belt of varying vertical breadth (usually from 400 to 800 feet) in which species of the two bordering zones commingle. The following table gives the extreme vertical limits of zones in Colorado:

Extreme vertical limits of zones in Colorado.

Zone.	Northern Colorado.		Southern Colorado.	
	Northeast exposure.	Southwest exposure.	Northeast exposure.	Southwest exposure.
	Feet.	*Feet.*	*Feet.*	*Feet.*
Upper Sonoran	..... to 5.600	..... to 6,500	..... to 6,500	..... to 7,800
Transition	5.600 to 7,500	6,500 to 8.200	6,500 to 8.000	7,800 to 9.000
Canadian	7,500 to 10,000	8,200 to 10,400	8,000 to 10,500	9.000 to 11,000
Hudsonian	10,000 to 10.900	10,400 to 11,600	10,500 to 11,200	11,000 to 12,000
Arctic-Alpine	10,900 to	11,600 to	11,200 to	12,000 to ......

UPPER SONORAN ZONE.

The entire base level of Colorado, comprising territory aggregating nearly half its area, or about 50,000 square miles, lies within the Upper Sonoran or arid division of the Upper Austral zone. As it is preeminently the agricultural zone of the State, it will be characterized in considerable detail.

East of the mountains the Upper Sonoran zone occupies a broad and continuous area of nearly uniform width, comprising the plains region, besides a stretch of rough and broken juniper country south of the Arkansas River and a narrow strip along the easternmost flanks of the foothills up to the point where the junipers (*Juniperus monosperma*) and pinyons (*Pinus edulis*) give way to the yellow pines of the Transition zone—at an elevation varying from 5,300 to 6,000 feet north of the Arkansas Divide, and from 6,200 to 7,300 feet farther south, according to the exposure and steepness of the foothill slopes. The upper (western) boundary of the eastern Colorado Upper Sonoran is tolerably regular from the Wyoming line south to the Arkansas Divide, where it bends far eastward to skirt this extensive Transition area. South of the Divide its regularity is further broken by a long, narrow arm which penetrates the mountains as far as Buena Vista, in the warm valley of the Arkansas, and to a less degree by westward extensions in the valleys of the Huerfano, Cucharas, and Las Animas Rivers still farther south. The following localities in the eastern foothill region well indicate the upper limit of the Upper Sonoran zone: Livermore, Arkins (2 miles west), Lyons, Boulder, Golden, Sedalia, Ramah (Arkansas Divide), Pikeview, Manitou (Fountain Creek Valley), Buena Vista (Arkansas Valley extension), Malachite (Huerfano Valley), La Veta (Cucharas Valley), and Weston (Las Animas Valley).

In western and southern Colorado the Upper Sonoran element occupies much smaller and extremely irregular areas. It is largely confined to long and sinuous arms or tongues in the warm, semidesert river valleys, which penetrate deeply the boreal country of the mountains and plateaus; but it also crosses some of the intervening watersheds at their lowest elevations and everywhere occupies the lowest slopes of mesas, plateaus, and ridges to an altitude of about 6,500 feet, regularly reaching 7,500 or even 7,800 feet on the steep southwestern slopes which many of the elevations present to the hottest rays of the sun.

West of the Continental Divide the Upper Sonoran zone embraces two regions of irregular outline separated in Colorado by the boreal cap of the Book Cliffs, although connected along the Green River Valley in Utah. The northern and smaller of these two areas is a southward extension of the Red Desert Upper Sonoran of Wyoming, connecting across the divide south of Bear River with the White River Valley extension of the Utah Upper Sonoran. Practically all of Routt and Rio Blanco Counties below 6,500 feet is included within this area. The northern half (western Routt County) is a region of extensive sage plains, while the rough region contiguous to the White River drainage is for the most part clothed with pinyons and junipers. The eastern and southern limits of this area are reached at or near the following localities: Dixon, Wyoming, Snake River Valley; Fortification, Colorado, west base Elk Head Mountains; half way between Hayden and Craig, Bear River Valley; north base Williams River Mountains; Hamilton, Williams Fork of Bear River; Axial, Axial Basin; north bases of Yampa and Wapiti Peaks; middle southwestern slopes of Danforth and Gray Hills; and northern base of White River Plateau, east in a rapidly narrowing tongue to a point on White River about 15 miles southeast of Meeker, where the Upper Sonoran is restricted to a narrow strip of pinyons and junipers occupying the warm southwestern slopes of the lowest hills bordering the river on the north. Narrow tongues extend southward in the valleys of Piceance and Bitter Creeks; thence the zone includes the eastern and northern bases and lower western slopes of Cathedral Bluffs, the northern bases of the Book Cliffs, and most of the valley of Evacuation Creek. In extreme western Routt County the westward continuity of the Upper Sonoran is interrupted by three arms of high country which extend a short distance into the State from Utah—the O-wi-yu-kuts Plateau and Diamond Peak on the north; the eastern extension of the Uinta Mountains, terminating in Mount Cullom, west of Green River; and, still farther south, the Yampa Plateau. East of Green River it is still further broken by the summits and upper northern slopes of the Escalante Hills, which form a Transition and Canadian zone island separated from the Uinta Mountains on the west and the Yampa Plateau on the south by a narrow tongue of Upper Sonoran zone extending through the Ladore Canyon of Green River on its warm eastern side and along the north side of the Yampa Canyon of Bear River.

South of the Book Cliffs the Upper Sonoran zone covers broad belts in the lower desert valleys of the Grand, Gunnison, Dolores, and San Juan Rivers and their chief tributaries. Over most of this region the pinyons, junipers, and other characteristic Upper Sonoran species of plants, birds, and mammals reach their limit of upward dispersion at a little over 7,000 feet elevation, but the variation due to slope exposure in a region so broken and incised is such as to prevent exact delimitation. Thus on the exposed southern faces of the Book Cliffs, from the Utah line east to the Little Book Cliffs, the upper limit conforms closely to the 7,000-foot contour; while on the remarkably bold and exposed slopes on the southwestern extremity of Grand Mesa, north of Delta, and also on the Landsend Peak, the most western point of the West Elk Mountains—unbroken slopes which rise directly out of the desert to a great height—the belt of junipers and pinyons can be traced to considerably over 8,000 feet, and probably occasionally reaches 8,500 feet. Looking north from Delta (4,950 feet) in the bottom of the Gunnison Valley to the bold southwest slope of Grand Mesa, a striking view is obtained of

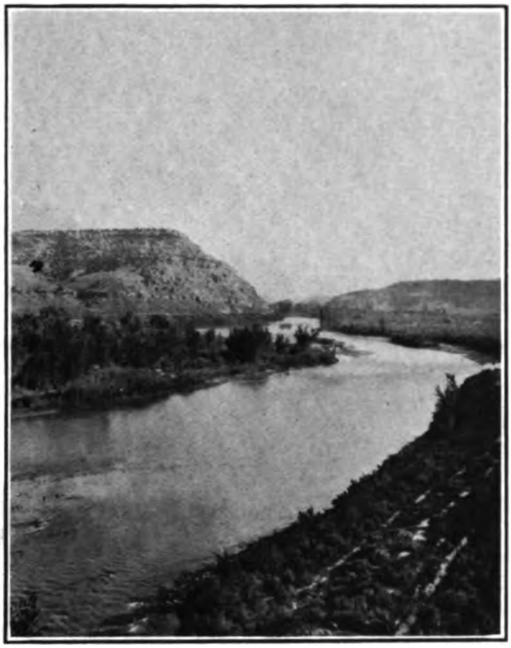

FIG. 1.—GRAND RIVER VALLEY NEAR DE BEQUE, SHOWING STRIP OF UPPER SONORAN ZONE.

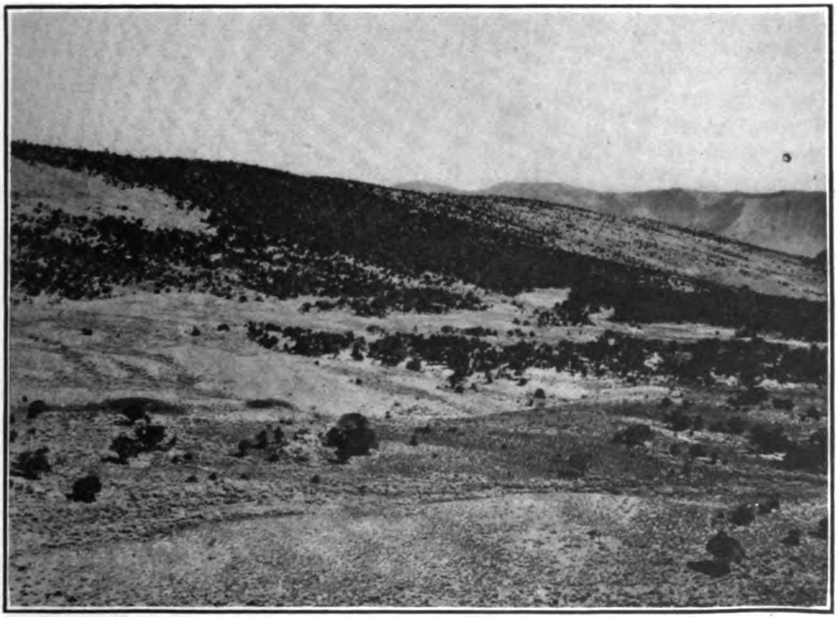

FIG. 2.—POCKET OF UPPER SONORAN ZONE ON SOUTHERN SLOPE, AT 7,500 FEET. NEAR MCCOY, GRAND RIVER VALLEY.

perhaps the greatest vertical breadth of the Upper Sonoran zone visible at any point in the State. In contrast to the conditions on warm exposed slopes is the cooling effect exerted by north and especially northeast slopes and canyon sides, shaded during the greater part of the day, and also by mountain streams, which together create an environment unfavorable for Upper Sonoran species above 6,000 feet. Examples of these conditions appear on the south side of Grand River below Glenwood Springs and also in the Grand Canyon a few miles above, where the Douglas spruces and other Transition zone forms occupy the slopes to below 6,000 feet; in constrictions of the Unaweep Canyon, which cuts through the Uncompahgre Plateau near its northern end; and in a great many other localities.

The Grand Valley Upper Sonoran enters Colorado from the Utah deserts in a broad belt and penetrates the high country in a long and sinuous tongue for over 150 miles in an east-northeast direction. East of Palisade, where the Little Book Cliffs and Grand Mesa approach each other, it is greatly narrowed, but again widens to include the valleys of Plateau and Roan Creeks. Between De Beque and Newcastle it is confined to a strip 2 or 3 miles wide along Grand River (see Pl. II, fig. 1), and east of Newcastle occupies a still narrower strip along the north side of the valley to Glenwood Springs, continuing up the Roaring Fork to Basalt. The continuity of the Upper Sonoran in the Grand Valley is broken by the Transition environment obtaining through the entire length of the Grand Canyon, from Glenwood to Dotsero, but the zone is again encountered in dilute form on the warm southern slopes of the lowest hills along the north side of Eagle River nearly to Wolcott. The Grand Valley between Dotsero and McCoy was not explored, but a well-defined Upper Sonoran pocket 4 or 5 miles in width was traversed on the northern side of the river at McCoy. At this point both pinyons and junipers were growing on the warm southern slopes up to 7,800 feet. (Pl. II, fig. 2.) The Upper Sonoran belt in the Gunnison and Uncompahgre Valleys is uniformly broad, and covers a greater area than that in the Grand Valley, of which it is an offshoot. Its eastern and southern limits are marked by Somerset (North Fork of Gunnison River), near River Portal (Gunnison Canyon), between Cedar Creek and Cerro Summit, and near Portland (Uncompahgre Valley).

Another extension of the Grand Valley Upper Sonoran follows southeast along the Dolores River, widening in the San Miguel and Paradox regions to include practically all the rough canyon country between the western escarpment of the Uncompahgre Plateau and the eastern flanks of the La Sal Mountains. Norwood is very near the eastern limit of the Upper Sonoran in the San Miguel Valley, and

Lavender marks its upper edge on Disappointment Creek, south of the San Miguel Mountains. South of the junction of the Disappointment with the Dolores this area connects across an extensive sage desert with a northward extension of the San Juan Upper Sonoran area, which covers practically all the extensive desert region lying west of Dolores River and south of the La Plata Mountains. Continuing eastward in the San Juan drainage, arms of this zone extend northward in the valleys of all northern affluents—along the Rio Las Animas to Durango, along the Rio Pinos nearly to Bayfield, and on the Rio Piedra to a point opposite the Piedra Padre, while along the San Juan it reaches nearly to Trujillo.

The intermountain region is penetrated by the Upper Sonoran zone only in the Rio Grande Valley. An arm of considerable breadth enters this region from New Mexico along the Rio Grande, where it is well characterized in a wide strip on each side of the river nearly as far as Alamosa. In a dilute form the Upper Sonoran element spreads over most of the open country as far as Del Norte, and north over the level plains of the San Luis Park to a little beyond Moffat. It includes also the belt of junipers and pinyons on the hot foothill slopes of the San Juan and Garita Mountains on the west and on the lower flanks of the Sangre de Cristo Range on the east side of San Luis Valley to an elevation of 8,500 feet, or about 1,000 feet above the mean level of the valley. The cold water in the many side streams of San Luis Valley—the Conejos, La Jara, Alamosa, Saguache, San Luis, Trinchera, Culebra, and the branches of the Rio Grande above Alamosa—carries narrow strips of Transition zone far out into the plain, and the immediate valleys of these streams can not be included in the Sonoran area.

The Upper Sonoran zone includes within the State two well-marked subdivisions differing considerably in their physical characteristics. These are the Great Plains region of eastern Colorado and the Great Basin region of western Colorado including San Luis Valley. Since each possesses a fauna and flora in a large degree peculiar and distinctive, they will be treated as minor distribution areas.

GREAT PLAINS DIVISION OF THE UPPER SONORAN ZONE.

With the exception of Las Animas County and parts of Pueblo, Otero, Bent, and Baca Counties, practically all of Colorado east of the foothills is a vast undulating grassy plain which varies in elevation from 3,000 and 4,000 feet along the eastern boundary to between 5,000 and 6,000 feet where it approaches the foothills. Throughout this region strips of sandy country alternate with areas of firm soils. The chief rivers are the Platte and Arkansas, which, with their many small tributary streams, drain most of the eastern part of the State through shallow valleys. A large number of these tributaries indicated upon maps are dry most of the year, and only a small proportion are perennial. Rock exposures are infrequent, being found chiefly in the eastern tier of counties, where some of the streams of the Republican River drainage, in seeking a lower level, have worn through beds of sandstone; and in northeastern Weld and northwestern Logan Counties. The plains are devoid of natural tree growth, except along the watercourses, which are usually fringed with cottonwoods, various species of willows, and dense thickets of wild plum and cherry, with scattering clumps of hackberry and box elder in the neighboring gulches and arroyos. A little sagebrush is found toward the north, in Weld and adjoining counties, but over most of the region the limited shrubbery is confined to the stream valleys. Range grasses in great variety grow luxuriantly on the plains and form the dominant vegetation.

The fauna and flora of this region are essentially those of the Great Plains, from Nebraska and South Dakota to the Panhandle of Texas. The following associations of mammals, birds, plants, and reptiles are more or less characteristic.

MAMMALS OF GREAT PLAINS.

Those mammals of the plains of eastern Colorado which are restricted to the Upper Sonoran zone are the large spotted and Kennicott spermophiles (*Citellus spilosoma major* and *C. obsoletus*); pale grasshopper mouse (*Onychomys leucogaster pallescens*); white-footed mouse (*Peromyscus leucopus tornillo*[1]); harvest mouse (*Reithrodontomys nebrascensis*); wood rats (*Neotoma cinerea rupicola, N. floridana baileyi,* and *N. micropus canescens*[2]); Hayden vole (*Microtus ochrogaster haydeni*); pocket gophers (*Geomys lutescens* and *Cratogeomys castanops*[3]); kangaroo rat (*Perodipus montanus richardsoni*); pocket mice (*Perognathus flavescens, P. flavus, P. hispidus paradoxus*); black-tailed jack rabbit (*Lepus californicus melanotis*); Bailey cottontail (*Sylvilagus auduboni baileyi*); long-tailed skunk (*Mephitis mesomelas varians*); prairie spotted skunk (*Spilogale interrupta*); long-eared and hairy-lipped bats (*Myotis evotis* and *M. californicus ciliolabrum*).

Other mammals which have their center of abundance in the Upper Sonoran zone, but are not entirely restricted to it, are the antelope (*Antilocapra americana*); striped spermophile (*Citellus tridecemlineatus pallidus*); prairie dog (*Cynomys ludovicianus*); white-footed mouse (*Peromyscus maniculatus nebrascensis*); coyote (*Canis nebracensis*); swift fox (*Vulpes velox*); badger (*Taxidea taxus*);

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[1] In brush fringe along streams only.

[2] Only in extreme southeast.

[3] Only in southeastern counties.

black-footed ferret (*Putorius nigripes*); long-tailed weasel (*Putorius longicaudus*); and the Say and brown bats (*Myotis subulatus* and *Eptesicus fuscus*).

BREEDING BIRDS OF GREAT PLAINS.

Among the characteristic Sonoran birds which breed on the plains are the following: California cuckoo (*Coccyzus americanus occidentalis*); burrowing owl (*Speotyto cunicularia hypugæa*); Arkansas kingbird (*Tyrannus verticalis*); Bullock oriole (*Icterus bullocki*); western grasshopper sparrow (*Ammodramus savannarum bimaculatus*); western lark sparrow (*Chondestes grammacus strigatus*); lazuli bunting (*Passerina amœna*); western blue grosbeak (*Guiraca cærulea lazula*); Bell vireo (*Vireo belli*); long-tailed chat (*Icteria virens longicauda*); catbird (*Dumetella carolinensis*); brown thrasher (*Toxostoma rufum*); and western mockingbird (*Mimus polyglottos leucopterus*).

Other birds breeding commonly on the plains, which are not so closely restricted to the Upper Sonoran zone, are: Upland plover (*Bartramia longicauda*); long-billed curlew (*Numenius americana*); mountain plover (*Podasocys montanus*); black-crowned night heron (*Nycticorax n. nævius*); bobwhite (*Colinus virginianus*); ferruginous rough-legged hawk (*Archibuteo ferrugineus*); mourning dove (*Zenaidura macroura carolinensis*); kingbird (*Tyrannus tyrannus*); thick-billed redwing (*Agelaius phœniceus fortis*); western meadowlark (*Sturnella neglecta*); bronzed grackle (*Quiscalus quiscula æneus*); lark bunting (*Calamospiza melanocorys*); western vesper sparrow (*Poœcetes gramineus confinis*); Brewer sparrow (*Spizella breweri*); white-rumped shrike (*Lanius ludovicianus excubitorides*); western yellowthroat (*Geothlypis trichas occidentalis*); and yellow warbler (*Dendroica æstiva*).

PLANTS OF GREAT PLAINS.[1]

Aside from the trees and larger shrubs along streams, including cottonwood (*Populus occidentalis*), several species of willows (*Salix*), box elder (*Acer negundo*), hackberry (*Celtis reticulata*), buffalo berry (*Lepargyrea argentea*), golden currant (*Ribes longiflorum*), wild plum (*Prunus americana*), chokecherry (*Prunus melanocarpa*), wolfberry (*Symphoricarpos occidentalis*), sumac (*Schmaltzia trilobata*), and false indigo (*Amorpha angustifolia*), the most conspicuous plants and smaller shrubs of the plains region are:

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[1] Throughout this report, with a few exceptions, the botanical nomenclature used is that of Rydberg, Flora of Colorado, Bull. 100, Colo. Agric. College Experiment Station, 1906.

Amorpha canescens.
Aragallus lamberti.
Artemisia filifolia.
Atriplex canescens (local).
Asclepias (several species).
Astragalus mollissimus.
Astragalus crassicarpus.
Cactus missouriensis.
Chrysothamnus plattensis.
Gaura coccinea.
Gutierrezia sarothræ.
Glycyrrhiza lepidota.
Helianthus lenticularis.
Ipomaea leptophylla.
Laciniaria punctata.
Leucocrinum montanum.
Lithospermum linearifolium.
Lupinus pusillus.
Malvastrum coccineum.
Meriolix serrulata.
Oenothera (several species).
Opuntia polyacantha.
Opuntia arborescens (Arkansas Valley and southward).
Peritoma serrulatum.
Petalostemon villosum.
Petalostemon oligophyllus.
Petalostemon purpureus.
Plantago purshi.
Psoralea lanceolata.
Psoralea hypogea.
Psoralea tenuiflora.
Prunus besseyi (in sandy country).
Touterea stricta.
Touterea nuda.
Townsendia (several species).
Ratibida columnaris.
Verbena hastata.
Verbena bracteosa.
Yucca glauca.

The following list of conspicuous grasses of the Great Plains of eastern Colorado is taken from a recent report of the Bureau of Plant Industry:[1]

Agropyron smithi.
Andropogon furcatus.
Andropogon halli.
Andropogon scoparius.
Aristida longiseta.
Bouteloua curtipendula.
Bouteloua hirsuta.
Bouteloua oligostachya.
Buchloe dactyloides.
Calamovilfa longifolia.
Festuca octoflora.
Koeleria cristata.
Muhlenbergia gracillima.
Muhlenbergia pungens.
Munroa squarrosa.
Panicum virgatum.
Redfieldia flexuosa.
Schedonnardus paniculatus.
Sitanion hystrix.
Sporobolus cryptandrus.
Stipa comata.

REPTILES AND BATRACHIANS OF GREAT PLAINS.

Most of the reptiles of eastern Colorado are common to the semiarid part of the Great Plains. Aside from the rattlesnake (*Crotalus confluentus*), bull snake (*Pituophis sayi*), blue racer (*Bascanion constrictor*), and hog-nosed snake (*Heterodon nasicus*), lizards are the most noticeable reptiles, particularly in sandy tracts. These comprise, among others, the horned toad (*Phrynosoma ornatissimum*), sand swift (*Holbrookia maculata*), whip-tailed lizard (*Cnemidophorus gularis*), and *Sceloporus consobrinus.* A large, beautifully colored ring-necked lizard (probably *Crotaphytus collaris*) reaches the plains of eastern Colorado in Baca County, in the extreme southeast, where it is reported as not uncommon. A salamander (*Ambystoma tigrinum*) from Loveland is in the Biological Survey collection.

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[1] Natural Vegetation as an Indicator of the Capabilities of Land for Crop Production in the Great Plains Area. Bureau of Plant Industry Bull. 201, pp. 20–62, March 16, 1911.

GREAT BASIN DIVISION OF UPPER SONORAN ZONE.

The Upper Sonoran area of Colorado lying in the drainage of the Rio Grande and Colorado Rivers is an integral part of the Great Basin region and differs from the Great Plains area in more arid climate and more barren and deeply eroded surface. A large proportion of its plants and animals are Great Basin forms, either specifically or subspecifically different from those of the Great Plains. Its open areas are generally characterized by the bunch-like growth of desert shrubs commonly termed sagebrush, grease brush, and rabbit brush, and the foothills and valley margins by a scrubby growth of junipers and nut pines. This area is best considered under its local subdivisions.

COLORADO RIVER DRAINAGE.

The territory embracing the open reaches in the warm lower valleys from Snake River south to the San Juan possesses a fauna and flora characterized by a large number of Great Basin desert forms, few of which show appreciable differentiation in passing through the entire width of the western Colorado Upper Sonoran. Considered locally, however, with respect to both faunal and physical characteristics, the Colorado River drainage readily admits of division into two minor distribution areas—the northwestern and southwestern sections.

NORTHWESTERN SECTION—COLORADO RIVER DRAINAGE.

A broad expanse of undulating sandy plains and low watersheds lying chiefly north of Bear River in west central Routt County is characterized by a dense growth of sagebrush (*Artemisia tridentata*). With an average elevation of 6,000 feet, this region is higher than the desert valleys to the south and has a mixture of Transition species in its fauna and flora. Its plants and animals, unlike those of the valleys of the Colorado drainage farther south, are partly derived from the Great Plains. The trees and shrubs, consisting of scattered cottonwoods, dense copses of willows, and thickets of buffalo berry, are confined to the banks of watercourses. A sparse growth of juniper covers the canyon sides and the steep faces of bluffs. The region is drained by the Snake and Bear Rivers, which flow through valleys of considerable depth—often through rugged canyons.

MAMMALS OF NORTHWESTERN SECTION—COLORADO RIVER DRAINAGE.

The following mammals characteristic of the Routt County sage plains have reached that region from the west and north, and most of them are absent from the southwestern valleys: The least chipmunk (*Eutamias minimus*), Wortman ground squirrel (*Callospermo-*

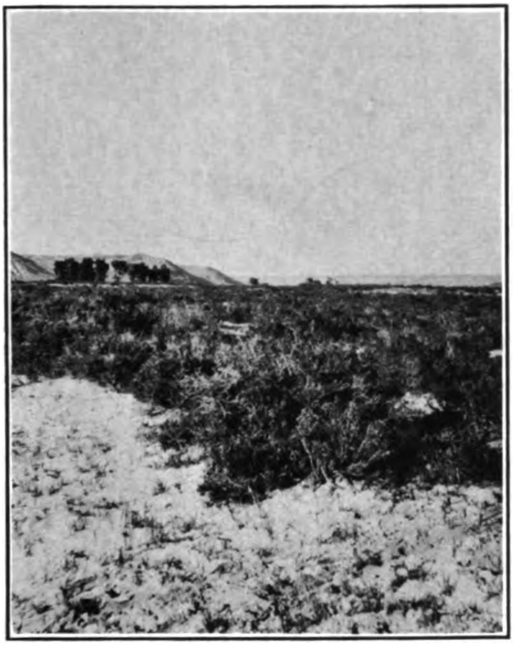

FIG. 1.—GREASEWOOD (SARCOBATUS VERMICULATUS) IN LOWER SNAKE RIVER VALLEY, ROUTT COUNTY.

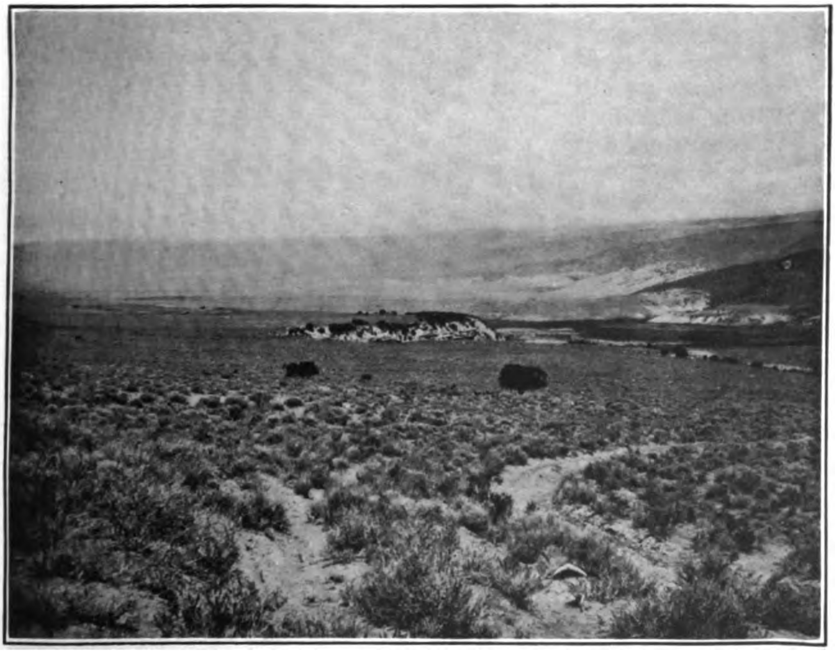

FIG. 2.—BENCH BORDERING VALLEY OF VERMILION CREEK, NORTHWESTERN ROUTT COUNTY.

The shrubbery is *Atriplex confertifolia* and *Grayia spinosa*, with *Juniperus monosperma* on bluffs.

philus lateralis wortmani), little striped ground squirrel (*Citellus tridecemlineatus parvus*), Idaho grasshopper mouse (*Onychomys leucogaster brevicaudus*), Red Desert pocket mouse (*Perognathus callistus*), Green River pocket gopher (*Thomomys clusius ocius*), and Fort Yuma bat (*Myotis yumanensis*). Species derived from the Great Plains region are *Peromyscus maniculatus nebrascensis, Perodipus montanus richardsoni, Sylvilagus auduboni baileyi, Canis nebracensis,* and *Myotis californicus ciliolabrum.* The long-eared bat (*Myotis evotis*) occurs on the plains on both sides of the mountains. Species which are common over this area but which regularly range higher are: *Lepus campestris townsendi, Citellus elegans, Cynomys leucurus, Neotoma cinerea orolestes,* and the gray wolf and antelope.

BREEDING BIRDS OF NORTHWESTERN SECTION—COLORADO RIVER DRAINAGE.

The sage sparrow (*Amphispiza nevadensis*), Brewer sparrow (*Spizella breweri*), and Bullock oriole (*Icterus bullocki*) are characteristic Upper Sonoran breeders in the low areas of northwestern Colorado, while the sage thrasher (*Oreoscoptes montanus*), white-rumped shrike (*Lanius ludovicianus excubitorides*), desert horned lark (*Otocoris alpestris leucolæma*), and San Diego redwing (*Agelaius phœniceus neutralis*) breed commonly but nest also in the Transition zone. The sage hen (*Centrocercus urophasianus*) is an occasional breeder, although restricted mainly to the Transition zone during the summer. Many Great Basin species of birds which are common breeders in the valleys of southwestern Colorado are noticeably absent from the northwestern valleys.

PLANTS OF NORTHWESTERN SECTION—COLORADO RIVER DRAINAGE.

Conspicuous shrubs and plants on the sandy sage plains of Routt County are *Artemisia tridentata, Opuntia polyacantha, Eurotia lanata,* and several species of *Chrysothamnus* and *Eriogonum;* on the adobe soil of the first and second benches above the streams, *Grayia spinosa, Atriplex nuttalli, A. canescens,* and *A. confertifolia* (Pl. III, fig. 2); on the alkaline flats in the valley bottoms, *Sarcobatus vermiculatus* (Pl. III, fig. 1), *Dondia erecta,* and, in damp places, *Salicornia herbacea;* on the rocky faces of bluffs, *Juniperus monosperma, Kunzia tridentata* (mainly Transition), *Ephedra antisyphylitica, Yucca glauca;* along streams, *Populus acuminata, Lepargyrea argentea, Salix amygdaloides,* and others.

REPTILES AND BATRACHIANS OF NORTHWESTERN SECTION—COLORADO RIVER DRAINAGE.

Reptiles are few in number compared with those in the valleys farther south. Rattlesnakes (*Crotalus confluentus*) and horned toads (*Phrynosoma ornatissimum*) were the only reptiles noted on the sandy sage plains in August, 1905, although the dainty mottled *Sceloporus* *graciosus* was collected among the rock ledges along the Bear River bluffs near Maybell, and also on Snake River, 20 miles west of Baggs Crossing. The leopard frog (*Rana pipiens*) is common in the streams of this section, a specimen having been collected on Vermillion Creek, near Ladore, September 3, 1906.

SOUTHWESTERN SECTION—COLORADO RIVER DRAINAGE.

Although traversed by such large perennial streams as the White, Grand, Gunnison, Dolores, and San Juan, and their numerous tributaries, this is, throughout, a region of great aridity, and presents the only truly desert conditions found within the State. Although small in area it is of great importance from both a biological and a horticultural standpoint. Most of the region is below 5,500 feet, the Grand Valley below Grand Junction being under 4,500 feet. In the extreme southwest, however, a few desert areas reach 6,000 feet. The larger part of the soils are to be classed as adobe. In common with all arid desert regions, the warm valleys of southwestern Colorado, when brought under irrigation, are remarkably productive, especially of fruit.

MAMMALS OF SOUTHWESTERN SECTION—COLORADO RIVER DRAINAGE.

The most representative of the mammals are the antelope squirrel (*Ammospermophilus leucurus cinnamomeus*), pale grasshopper mouse (*Onychomys leucogaster pallescens*), golden-breasted canyon mouse (*Peromyscus crinitus auripectus*), big-eared harvest mouse (*Reithrodontomys megalotis*), desert wood rat (*Neotoma desertorum*),[1] golden pocket gopher (*Thomomys aureus*), Moki kangaroo rat (*Perodipus longipes*), Apache pocket mouse (*Perognathus apache*), cottontail rabbit (*Sylvilagus auduboni warreni*), Texas jack rabbit (*Lepus californicus texianus*), cacomistle (*Bassariscus astutus flavus*), Arizona skunk (*Mephitis estor*), Great Basin spotted skunk (*Spilogale gracilis saxatilis*), coyote (*Canis estor*), and the bats, *Antrozous pallidus*, *Myotis californicus*, *M. evotis*, *Pipistrellus hesperus*, and *Nyctinomus mexicanus*.

BREEDING BIRDS OF SOUTHWESTERN SECTION—COLORADO RIVER DRAINAGE.

A few of the most characteristic breeding birds are the California quail (*Lophortyx californicus*),[2] ash-throated flycatcher (*Myiarchus cinerascens*), house finch (*Carpodacus mexicanus frontalis*), Arkansas goldfinch (*Astragalinus psaltria*), black-throated sparrow (*Amphispiza bilineata*), western blue grosbeak (*Guiraca cærulea lazula*), and canyon wren (*Catherpes mexicanus conspersus*). Practically all the Upper Sonoran birds found on the northwestern sage plains breed more or less commonly in the desert valleys, as do also a number of species which are common to the Upper Sonoran areas on both sides of the mountains.

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[1] Taken in White River Valley only.

[2] Introduced.

PLANTS OF SOUTHWESTERN SECTION—COLORADO RIVER DRAINAGE.

This region is especially marked by a large number of Upper Sonoran desert shrubs and plants, most of which extend into Colorado only a short distance on the west and southwest, being peculiar to the desert areas of the southwestern United States. Important among these are:

Berberis fremonti.
Coleogyne ramosissima.
Cowania mexicana.
Echinocactus whipplei spinosior (McElmo).
Ephedra antisyphylitica.
Ephedra torreyana.
Fraxinus anomala.
Grayia spinosa.
Lycium pallidum.
Opuntia whipplei.
Rhamnus smithi.
Yucca baccata.
Yucca harrimaniæ.

Other plants and shrubs of more general distribution in the Colorado Upper Sonoran which are found commonly in the southwestern desert valleys are:

Atriplex confertifolia.
Atriplex canescens.
Atriplex nuttalli.
Dondia erecta.
Eurotia lanata.
Echinocereus paucispinus.
Lepargyrea argentea.
Opuntia camanchica.
Opuntia rhodantha.
Populus wislizeni.
Populus acuminata.
Sarcobatus vermiculatus.
Schmaltzia trilobata.
Ximenesia exauriculata.

REPTILES AND BATRACHIANS OF SOUTHWESTERN SECTION—COLORADO RIVER DRAINAGE.

A large variety of reptiles, especially lizards, characterize the Upper Sonoran zone in the hot valleys and on the slopes of western Colorado, and several lizards which reach their greatest abundance in the Lower Sonoran zone of the southwest United States are represented. Probably all have reached this region from the southwestern deserts. Following are some of the most important reptiles, with brief notes on their distribution:[1]

Crotaphytus collaris baileyi.—This ring-necked lizard is abundant in the McElmo and Montezuma Valleys, east to a point 6 miles north of Cortez, at 6,500 feet; also in the San Miguel region ranging east to Coventry (6,500 feet); present in west Paradox Valley (western rim at 6,500 feet), Salt Canyon, and other branches of the canyon of the lower Dolores River. Equally common on open deserts and in rocky pinyon country. I took two specimens at McElmo, June 17, 1907, and one each at Coventry and Sinbad Valley, July 13 and 17, 1907.

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[1] Many of the lizards of the desert valleys range up for some distance into the pinyon belt; but as no species appears to be restricted to the upper part of the zone, the present list will include notes bearing on both these areas.

Uta stansburiana.—This little desert lizard has a general distribution from the Grand Valley southward, chiefly below 6,000 feet, but rarely to 7,000 feet (Spruce Tree Cliff Ruins, Mesa Verde). It was found in the following localities: Desert north of Mack; Plateau Creek; Coventry; Paradox Valley; Salt Canyon; Dolores River Canyon; and McElmo. A very abundant lizard, usually occurring among rocks, but often on the open desert. The specimens are from Mack, Plateau Creek, and De Beque, September 25 and 30 and October 1, 1906, and McElmo, June 18, 1907.

Uta ornata.—A rock-inhabiting species of delicate profile and slight build, often scarcely discernible on account of its peculiarly protective colors and thin body. Present in most of the valleys from Grand River south to the San Juan. Represented by six specimens from Plateau Creek, September 30, 1906, and one each from Mesa Verde (Spruce Tree Cliff Ruins, 7,000 feet), June 13, and Coventry, July 29, 1907, and observed in Sinbad Valley and at McElmo and Arboles.

Sceloporus elongatus.—The large gray scaly rock lizard has a wide distribution, north at least to Bear River, and ranging through the entire width of the Upper Sonoran zone, and also a short distance into the Transition zone. In eastern Colorado noted only at Arkins. Found chiefly about rocks. Specimens from Arkins; Escalante Hills (7,000 feet); Meeker; Rangely; Plateau Creek; and McElmo.

Sceloporus consobrinus.—A medium-sized species, inhabiting rock ledges in the pinyon and juniper country up to 7,000 feet. Smaller than the preceding species and not nearly so common. Specimens are from Douglas Spring (Escalante Hills); La Veta; and Arboles.

Sceloporus graciosus.—A small graceful lizard, usually noted among greasewood (*Atriplex* and *Sarcobatus*) in open valleys and desert flats, chiefly below 5,500 feet. It was common at the following localities: Escalante Hills; valleys of Texas and Evacuation Creeks in extreme western Rio Blanco County; lower Grand Valley north of Mack; Rifle; Coventry; and McElmo.

Phrynosoma ornatissimum.—Horned toads are common at McElmo and on the desert north of Mack, Mesa County, and are reported elsewhere between 5,000 and 6,000 feet.

Cnemidophorus tigris.—This large whip-tailed lizard ranges into the State only in the lowest and hottest desert valleys, extending up to about 5,500 feet. It is tolerably common in the lower McElmo Valley, and abundant in West Paradox and Sinbad Valleys and also in the Dolores River Canyon as far down as the mouth of West Creek, frequenting sandy flats which are clothed with *Atriplex* and *Sarcobatus*. It doubtless occurs also in the lowest part of the Grand Valley near the Utah boundary, as I found it on Plateau Creek, 5 miles east of Tunnel, Mesa County. Represented by two specimens from

Plateau Creek September 30, 1906, and one from McElmo June 18, 1907. This species has its center of abundance in the arid Lower Sonoran zone.

Cnemidophorus gularis.—A medium-sized species not uncommon in the lowest valleys below 5,500 feet, in same situations as *C. tigris.* I collected specimens at Grand Valley October 2, 1906, near McElmo June 22, 1907, and at Hotchkiss August 8, 1907. It was observed also in Salt Canyon and in the canyon of Dolores River near the mouth of West Creek.

Bascanion tæniatum.—This handsome and graceful snake enters the State, so far as known, only in the Grand River Valley, where a specimen was taken on Plateau Creek September 30, 1906, and another at Morris, west of Rifle, August 13, 1907. The Plateau Creek individual climbed bushes with great ease, while the one from Morris was discovered among beds of prickly pear on a sandy knoll. Both localities are below 5,300 feet.

Thamnophis elegans vagrans.—This garter snake was taken at Meeker, Rio Blanco County, August 11, 1905.

Crotalus confluentus.—Rattlesnakes are not at all common, but are reported in most localities.

Pituophis sayi.—A bull snake was taken on Dry Creek, 8 miles west of Naturita, July 20, 1907.

Scaphiopus hammondi.—Numbers of these toads were caught in my mousetraps among beds of prickly pear on a sandy knoll at Morris, west of Rifle, August 15, 1907, at 5,200 feet.

Bufo lentiginosus woodhousei.—This toad was taken at Rangely September 12, 1906, and also at Rifle August 15, 1907.

Chorophilus triseriatus.—A specimen of this little frog was collected at Rangely September 13, 1906, at 5,500 feet.

RIO GRANDE DRAINAGE.

The Upper Sonoran element which follows up the Rio Grande Valley and in dilute form spreads over the level expanse of San Luis Park is mainly characteristic of the arid valleys of western Colorado. It includes among mammals *Antilocapra*, *Eutamias minimus caryi*,[1] *Citellus tridecemlineatus parvus*, *Onychomys leucogaster pallescens*, *Reithrodontomys montanus*,[1] *Thomomys aureus pervagus*, *Perodipus montanus*,[2] *Perognathus flavus* and *P. apache*, *Sylvilagus auduboni warreni*, and *Lepus californicus texianus* (?). Among plants and shrubs the various greasewoods (*Sarcobatus* and *Atriplex*), rabbit brush (*Chrysothamnus*), and sages (*Artemisia* and *Eurotia*) predominate, while *Gutierrezia*, *Grindelia*, *Helianthus*, *Ximenesia*, *Peritoma* (especially *P. sonoræ*), *Yucca*, and *Opuntia* are conspicuous genera on the arid plains. The Rio Grande, Conejos, and other streams are fringed in many places with thickets of *Ribes longiflorum* and *Schmaltzia trilobata*, while willows and broad-leaved cottonwoods are abundant.

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[1] Restricted to San Luis Park and Rio Grande Valley, so far as known.

[2] San Luis Park, Rio Grande Valley, and intermountain valleys of northern New Mexico.

JUNIPER AND PINYON BELT.

A belt of country clothed with juniper and pinyon, uniformly rough and broken in configuration, marks the higher part of the Upper Sonoran zone on the basal flanks of all the mountains in Colorado except the Front Range.[1] These two species (*Pinus edulis* and *Juniperus monosperma* [2]) form the characteristic tree growth on the slopes between the yellow pine belt of the higher foothills and the open plains or desert valleys at their bases. They also densely clothe extensive areas partially removed from the main mountain ranges, comprising in western Colorado practically all the lower elevations and the rough country forming the watersheds between the valleys (see Pl. IV), and east of the mountains a region of alternating canyons and ridges extending from southeastern Pueblo and eastern Huerfano Counties southeast to western Baca County. The pinyons grow to a higher elevation than the junipers, extending a short distance into the Transition zone. They occasionally reach 8,500 or 9,000 feet on hot slopes, as on the western side of the Sangre de Cristo Range, the eastern side of the Arkansas Valley between Salida and Buena Vista, and the bold southwest exposures of Grand Mesa and Sierra Blanca. They are not found as low as the junipers, however, and are usually absent from the rough areas below 5,500 feet.

Most of the mammals, birds, and plants of the juniper and pinyon country in Colorado are more or less characteristic of this belt over much of the Great Basin region. Few of the species are found on the Great Plains, and the fauna and flora as a whole belong to the Great Basin division of the Upper Sonoran zone.

MAMMALS OF JUNIPER AND PINYON BELT.

The following mammals represent the Upper Sonoran element in the juniper and pinyon belt in different parts of the State. On both slopes of the mountains: Rock squirrel (*Citellus variegatus grammurus*), cliff mice (*Peromyscus truei* and *P. boylei rowleyi*), and gray fox (*Urocyon cinereoargenteus scotti*). In western Colorado only: Hopi chipmunk (*Eutamias hopiensis*), golden-breasted canyon mouse (*Peromyscus crinitus auripectus*), Arizona wood rat (*Neotoma cinerea arizonae*), cacomistle (*Bassariscus astutus flavus*), Great Basin spotted

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[1] North of the Arkansas Divide the yellow pines of the Transition zone usually extend down to the edge of the plains, the juniper belt being but slightly indicated on a few outlying ridges and talus slopes by a very sparse growth.

[2] A third, *Juniperus scopulorum*, is common in the upper part of this belt, but also extends up through the Transition zone.

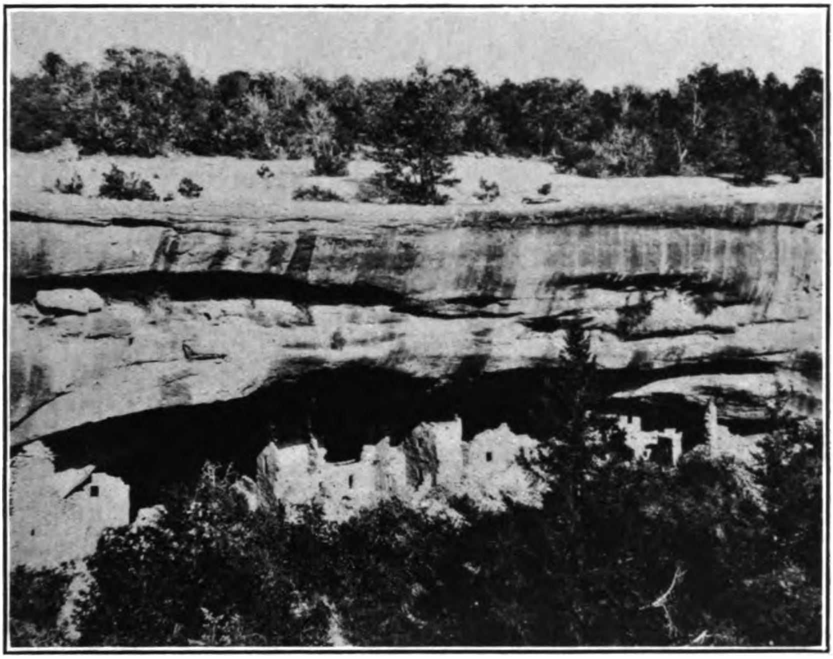

FIG. 1.—SPRUCE TREE CLIFF RUINS, NAVAJO CANYON, MESA VERDE, WITH JUNIPER AND PINYON FOREST IN THE ROUGH CANYON COUNTRY OF SOUTHWESTERN COLORADO.

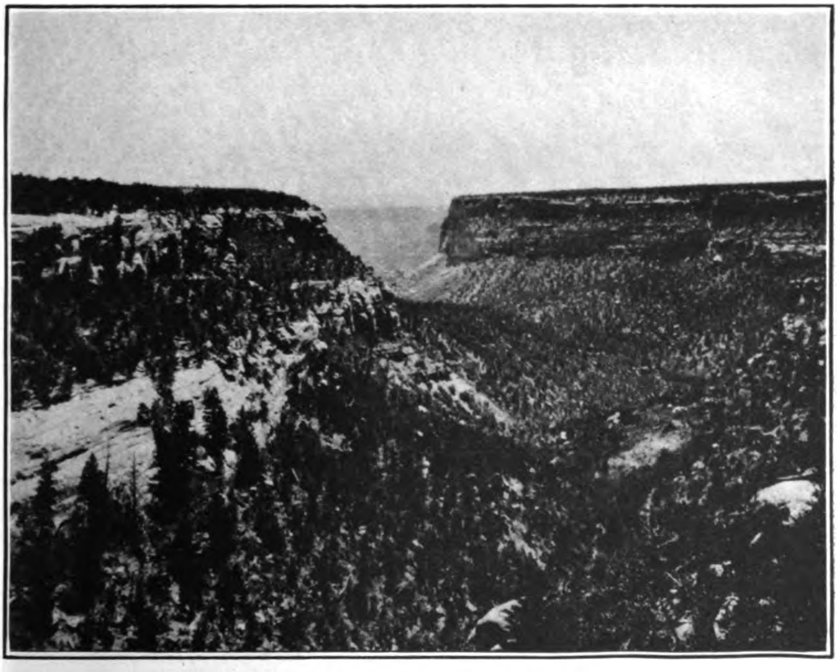

FIG. 2.—NAVAJO CANYON, MESA VERDE.

Characteristic view in rough canyon region of southwestern Colorado, showing dense growth of junipers and pinyons at 7,000 feet. Scattering Douglas spruces are on cool slope at left.

skunk (*Spilogale gracilis saxatilis*), and Arizona skunk (*Mephitis estor*). In the Escalante Hills: Utah chipmunk (*Eutamias dorsalis utahensis*). In southeastern Colorado: Warren wood rat (*Neotoma albigula warreni*).

BREEDING BIRDS OF JUNIPER AND PINYON BELT.

Breeding birds of general distribution in this belt are the Woodhouse jay (*Aphelocoma woodhousei*), pinyon jay (*Cyanocephalus cyanocephalus*), gray titmouse (*Bæolophus inornatus griseus*), lead-colored bush tit (*Psaltriparus plumbeus*), western gnat catcher (*Polioptila cærulea obscura*), and Baird wren (*Thryomanes bewicki bairdi*). The canyon towhee (*Pipilo fuscus mesoleucus*), scaled quail (*Callipepla squamata*), and the road runner (*Geococcyx californianus*) are common breeders in the juniper country of southeastern Colorado, but the quail and road runner breed also in the open valleys of the region and in the Lower Sonoran zone.

PLANTS OF JUNIPER AND PINYON BELT.

The vegetation of the juniper belt shows a great preponderance of Upper Sonoran species. Conspicuous among them are:

Juniperus monosperma.
Juniperus utahensis (west Colorado).
Pinus edulis (also lower Transition).
Fendlera rupicola.
Philadelphus microphyllus.
Fallugia acuminata (San Luis Valley region).
Cowania mexicana (southwestern Colorado).
Peraphyllum ramosissimum (also lower Transition).
Cercocarpus parvifolius.
Atriplex canescens (locally common).
Schmaltzia trilobata.
Quercus (several species).
Celtis reticulata (rare).
Ephedra antisyphylitica (west Colorado).
Ephedra torreyana (southwestern Colorado).
Echinocereus aggregatus (southeastern Colorado).
Echinocereus viridiflorus.
Cactus radiosus.
Opuntia arborescens (southeastern Colorado).
Opuntia whipplei (southwestern Colorado).
Yucca baccata (southern Colorado).
Yucca harrimaniæ (southwestern Colorado).

AGRICULTURAL IMPORTANCE OF COLORADO UPPER SONORAN ZONE.

Although entirely within the arid region and embracing areas of great aridity, the Upper Sonoran zone in Colorado is nevertheless of great agricultural importance. It is the only zone which affords suitable physical and temperature conditions for extensive and varied agriculture. With a light and insufficient annual rainfall, which varies from 15 or 20 inches on the eastern plains to less than 10 inches on some of the western desert tracts, and a remarkably dry atmosphere (average relative humidity about 50 per cent), the rich agricultural and fruit districts on both sides of the mountains have necessarily been developed largely by irrigation. It is true that a certain measure of success with corn, cane, and cereal crops is attained through dry farming in many sections on the eastern plains where no water for irrigation is available; and as the various systems of soil culture come into more general use and are made more effective in conserving rainfall, the hard and loam soil tracts should become increasingly productive. The great agricultural wealth of the State has been built up mainly, however, along the base of the foothills and in the valleys of the larger streams, and this area of greatest production will always be limited by the water supply.[1]

The distribution of Upper Sonoran crops is at present local; and so dependent are many of the crops upon natural protection, adequate water supply, and suitable soils, entirely aside from temperature, that they can not be grown over the whole of a region so varied as the Upper Sonoran of Colorado. The State is noted for its thrifty, scattered agricultural communities, some of which have become famous as producers of particular crops. Thus the production of potatoes on the plains of the Greeley region is enormous, as is also the yield of watermelons and cantaloupes at Rocky Ford, in the warm Arkansas Valley, and of peaches in the hot desert valley of Grand River near Grand Junction and Palisade. Sugar beets are a staple crop in the Platte and Arkansas Valleys, where a number of large sugar factories take care of the product, and they are grown extensively in the Grand Valley below Grand Junction. The raising of a great variety of vegetables on a large scale for canning is an important industry fostered by the establishment of several canneries in the region between Longmont and Fort Collins. Wheat and oats are important crops east of the mountains, and yield heavily under irrigation. Even the moderate yield now secured under dry farming warrants a large acreage under improved methods of handling the soil. Both of these cereals are successfully grown on moderate slopes and benches bordering many of the desert valleys in western Colorado. (See Pl. V, fig. 1.) A small acreage of corn is grown on the eastern plains, but it is not a sure crop west of the mountains, owing to the prevalence of cool nights during the growing season. Among the hay and forage crops alfalfa easily takes the lead, yielding two cuttings in the upper part of the zone, above 6,000 feet, and three or four in the warmer parts.

The leading fruit districts lie at the eastern base of the foothills and in the desert valleys of the western slope. The region from Boulder north to Fort Collins is noted for apples and small fruits, and most varieties of strawberries, raspberries, blackberries, currants, plums, and cherries thrive in this section. The Florence and Canon City district, in the Arkansas Valley, also is a heavy producer of berry

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[1] Vitally essential to the agricultural interests of the State are the mountain forests. Many authorities maintain that they induce precipitation; they also conserve moisture by holding the snows of winter, thus insuring a regular supply of water in the streams well into the growing season.

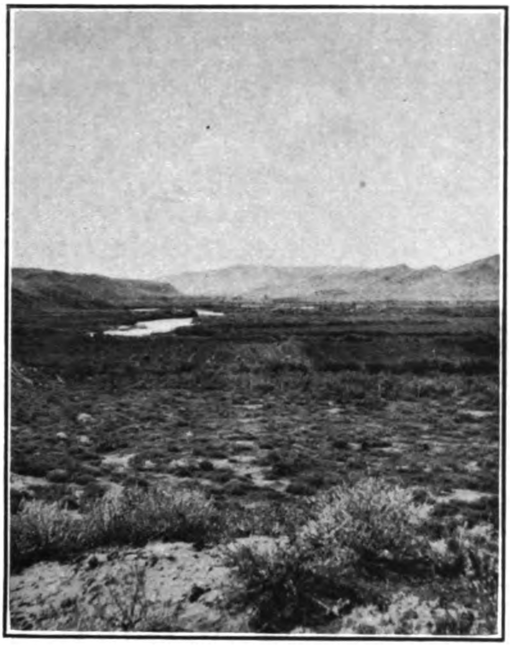

FIG. 1.—FARMS IN THE LOWER WHITE RIVER VALLEY BELOW RANGELY, AT 5,500 FEET.

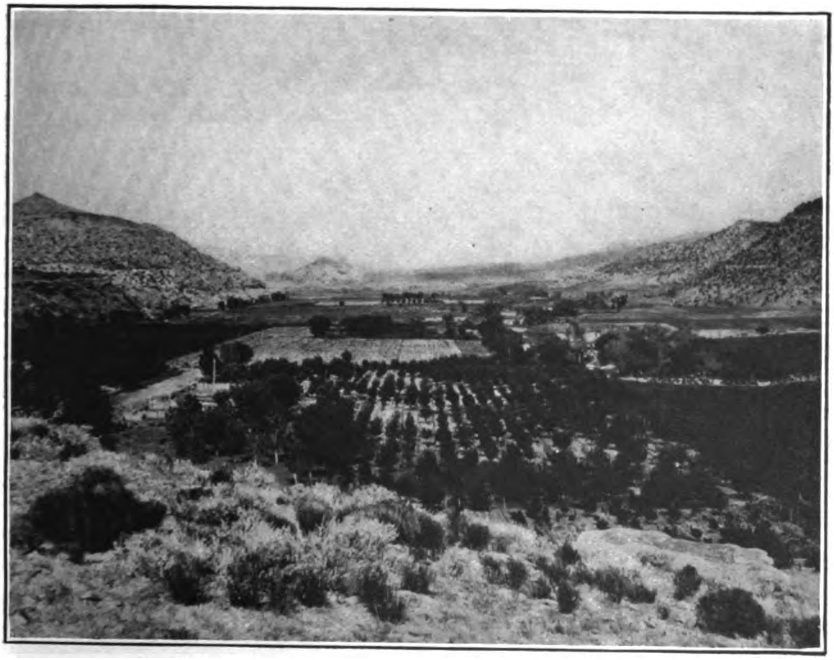

FIG. 2.—FRUIT RANCHES IN THE MCELMO VALLEY BETWEEN MOQUI AND MCELMO, AT 5,200 FEET.

fruits and apples. The western desert valleys are peculiarly adapted to a great variety of Upper Sonoran fruits, as apples, pears, peaches, prunes, apricots, and nectarines, while even almonds and peanuts have been successfully raised in a few of the warmer localities. (See Pl. V, fig. 2.) Many hundred carloads of peaches, apples, and pears are shipped annually from the lower Grand, Gunnison, and Uncompahgre Valleys, the chief shipping points being Fruita, Grand Junction, Palisade, Delta, Hotchkiss, Paonia, and Montrose. The adobe soils which prevail in most of the desert tracts prove wonderfully productive under irrigation, and the transformation wrought in a few years by water is little short of marvelous.

At present most of the eastern plains region and the sage plains of Routt County are used for grazing, but all the hard and loam soil tracts will doubtless eventually be brought under cultivation. The extensive sandy areas, with their luxuriant growth of range grasses, are well suited to grazing, but are also especially adapted to certain crops.[1] The short-grass plains which form the watershed between the Arkansas and Cimarron Rivers, in the extreme southeast, are arable throughout, and are being gradually reclaimed by dry-farming methods.

The intimate connection between the natural life zones and the crop zones has already been referred to. The same isotherms which limit the upward or northward dispersion of certain associations of native plants, birds, and mammals are found to limit effectively the successful production of certain fruits and other crops. The varieties of fruits, cereals, and miscellaneous crops which have proved best adapted to the Upper Sonoran zone in various parts of the western United States have been listed by Merriam.[2] In this zone the standard varieties of apples, plums, and cherries, the sugar beet, most of the cereals, and many other fruits and vegetables, reach their highest development and productiveness. It is not likely that all the varieties listed will prove an unqualified success in the Upper Sonoran of Colorado, but the tables furnish valuable aid in selecting suitable varieties. Presupposing suitable soil and water conditions, any intelligent fruit grower or farmer with a fair knowledge of the distribution and character of the Upper Sonoran element should be reasonably certain whether the proper temperature conditions for the maturing of particular fruits and crops are present in a given locality. Such knowledge is of special value along the upper edge of the zone, where, among the lower foothills and in regions of broken configuration, agriculture and horticulture, following the line of least resistance, are now very largely confined to the stream valleys. These are frequently descending tongues of the Transition zone, and the cooling influence of the streams very often causes the entire valley bottoms to be filled with Transition vegetation. From the nature of the case most of the Upper Sonoran fruits and crops tested in these valleys have proved either a total failure or only a partial success, and after long experimentation have been replaced by the hardier varieties of the Transition zone. Many of the experiments might have succeeded had they been tried in the warm pockets or on the moderately inclined slopes along the warm sides of the valleys, and had the rainfall been utilized by cross furrowing and ditching. These warm exposures are covered with Upper Sonoran vegetation, are occasionally open, but more often clothed with scattering pinyons and junipers, and in many cases, with a little clearing of rocks and shrubbery, are quite capable of cultivation. Many ranchmen have already discovered the advantages of such locations for fruit raising, but along the bases of the mountains are considerable areas of such land, still unreclaimed, which under present methods of conserving and handling the water supply are capable of producing the finest Upper Sonoran fruits.

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[1] Natural Vegetation as an Indicator of the Capabilities of Land for Crop Production, Bureau of Plant Industry Bull. 201, pp. 75-78, 1911.

[2] Life Zones and Crop Zones, Bull. 10, Biological Survey, pp. 37-40.

Although the larger part of the open San Luis and Rio Grande Valleys is included in the Upper Sonoran on the zone map, this region is very nearly on the border line between the Upper Sonoran and Transition zones, with a slight preponderance of Upper Sonoran species. This area is generally considered too cold for Upper Sonoran crops and fruits, and few have been grown thus far. This is not strange, however, since the part reclaimed for agriculture is very largely in valleys of streams, whose cooling effect precludes the successful cultivation of any but the hardy vegetables and cereals of the Transition zone. Warmer conditions are indicated on all the bordering foothill slopes by a belt of junipers, pinyons, and other Upper Sonoran vegetation, which extends from 1,000 to 1,500 feet above the level of the valley and continues out into the open country for some distance along the the warm sides of ridges. The warmest and most protected slopes are at the base of the foothills, and many of them are open and, with little clearing, suitable for cultivation. That certain of the hardier Upper Sonoran fruits, particularly apples,[1] can be successfully grown on these warm, protected slopes, wherever water is obtainable, seems highly probable, and the advantage of fruit growing in an extensive isolated agricultural region like the San Luis Valley is apparent.

An advantage of fruit raising in the foothills is the protection they afford from the cold winds which sweep the plains in winter. An added advantage is that, owing to the altitudinal difference in the progress of the season, fruit in the foothill districts often escapes injury from a late spring frost which catches the fruit of the lower country in full blossom. This was notably the case in 1907, when late frosts were general over the fruit districts on both sides of the mountains, greatly diminishing the crop.

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[1] In various parts of the southwest the pinyon belt has proved especially adapted to apples. Perhaps the best example within the State is in Montezuma Valley and the neighboring country, where in the natural openings and clearings among the pinyons the very finest apples are grown. When water from the several large ditches now under construction is available, apple growing will become one of the most important industries of southwestern Colorado.

The protection afforded in the foothill valleys of western Colorado is especially favorable to peach growing. The lower edge of the pinyon belt appears to limit the successful growing of peaches, nectarines, tomatoes, and melons over most of the region, but under favorable conditions peaches have been grown somewhat higher. In eastern Colorado peach growing is not carried on to any great extent. At Canon City the average is about two crops every five years. This failure is not due to coldness of climate, for the mean temperature is unusually high, but to long spells of warm weather in winter, which cause the buds to start, whereupon a sudden cold snap freezes them.

The many long arms or extensions of the Upper Sonoran zone in western Colorado have a special value in that, deeply penetrating the high country of the Transition and Boreal zones, they enable the cultivation of Sonoran fruits and crops to be carried far within regions devoted to mining and stock raising, and thus render their production more lucrative than elsewhere. An excellent example is the narrow, semidesert Grand River Valley, between Grand Junction and Glenwood Springs.

With the completion of the Gunnison Tunnel (through which water from the Gunnison River is to reach 150,000 acres of desert land in the Uncompahgre Valley) and many other private irrigation projects of less scope, the ranchmen of western Colorado in particular are rapidly awakening to the great possibilities of irrigation and to the fact that fruit raising is far more remunerative, acre for acre, than ranching and hay raising.

TRANSITION ZONE.

In general this may be said to be the foothill zone of Colorado, with its lower limit marked by the edge of the plains on the east and by the approach to desert conditions along the western bases of the mountains and plateaus. It is a neutral distribution area of considerable breadth lying between the Boreal (Canadian) and Austral (Upper Sonoran) regions, and elements of both zones enter about equally into its composition. Although a number of species of mammals, birds, and plants are wholly or mainly restricted to the Transition zone and characterize it locally, it is best marked on the whole as a region of overlapping boreal and austral species.[1]

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[1] See Merriam, Proc. Biol. Soc. Wash., VII, p. 31, 1892.

In addition to occupying continuous belts in the broken foothill country which flanks both sides of the main ranges, the Transition zone covers large areas in North Park, the upper Bear River Valley, the Wet Mountain Valley, Archuleta County south of the San Juan Mountains, on the Arkansas Divide with the adjacent region bordering the South Platte, and elsewhere. Many outlying elevations in western Colorado, chiefly secondary plateaus descending toward the Colorado River, are capped with this zone. Among these are the Mesa Verde, in Montezuma County, and the Yampa Plateau and Escalante Hills in western Routt County. It covers also most of the mountains west of the Ladore Canyon of Green River, forms a narrow belt around the Canadian zone summit of the O-wi-yu-kuts Plateau, occupies the summits of the higher eastward projecting flanks of the La Sal Mountains in western Montrose County, and is present in dilute form (indicated by pockets of *Pseudotsuga*) on the upper northeast faces of the Rabbit Hills, in western Rio Blanco County. On the east side of the mountains the only Transition zone island of consequence is on the summit of the Mesa de Maya, in southern Las Animas County. The total area in Colorado covered by the Transition zone is in the neighborhood of 25,000 square miles, or approximately one-fourth of the area of the State.

Warm slopes in various parts of the State having an unusual exposure to the direct rays of the sun carry Transition species anywhere from 500 to 1,000 feet above the mean zone level. A few examples are a southwest slope 1 mile northeast of Lake San Cristobal, near Lake City, where scattering yellow pines are encountered up to 10,000 feet; at Bath, on the summit of Trout Creek Pass, and along the western slopes of the Trout Pass Hills, where the same tree occurs regularly up to 9,500 feet and sparingly among the Douglas firs for another 300 feet; and on the eastern slope of the Sangre de Cristo Range in the Mosca Pass region, where the pines are common at 9,500 feet. Transition zone vegetation is carried to an abnormal elevation also on the remarkably exposed southwest slopes of Sierra Blanca and Grand Mesa, and on Badito Peak, the southernmost point of the Wet Mountains. (See Pl. VI, fig. 1.)

An excellent illustration of warmer environmental conditions created through deforestation, and a consequent upward extension of Transition zone species, is afforded on the mountains north of and adjacent to Clear Creek, just east of Fall River. The southwest side of a mountain between Fall River and Russell Gulch is clothed to the summit, at 9,000 feet, with a dwarfed growth of *Pinus scopulorum*, intermixed with *Pseudotsuga mucronata* and *Pinus flexilis*, and such shrubs as *Acer glabrum* and *Cercocarpus parvifolius*. The upper 500 feet of this slope is said to have been forested with *Pinus murrayana* in early days before mining activities exhausted the best forests of

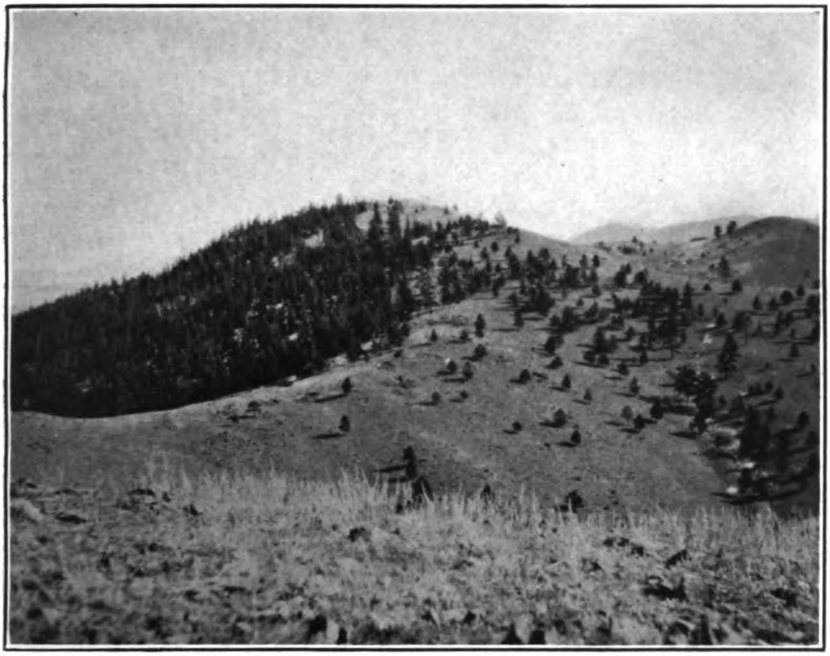

FIG. 1.—EFFECT OF SLOPE EXPOSURE.

Yellow pines (*Pinus scopulorum*) and firs (*Abies concolor*) growing at same elevation (9,000 feet) on hot and cold slopes in Wet Mountains east of Westcliffe.

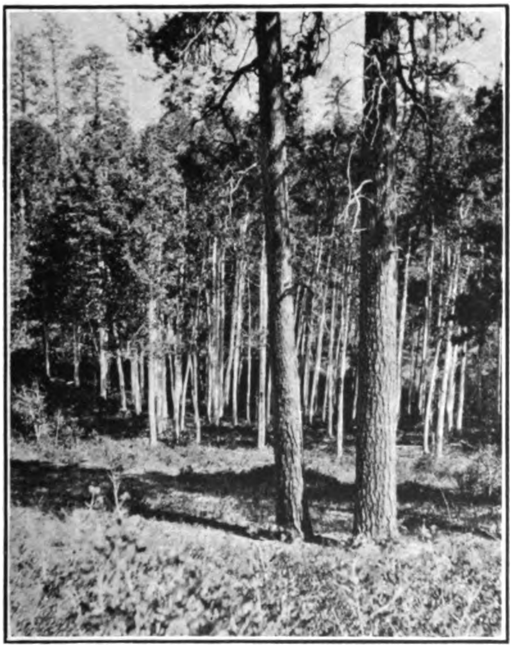

FIG. 2.—CHARACTERISTIC VIEW AT UPPER EDGE OF TRANSITION ZONE.

Undergrowth of small aspens (*Populus tremuloides*) in forest of yellow pine (*Pinus scopulorum*) on Dolores Plateau.

the region, and many stumps still remain. At present the summit and upper northern slopes of this mountain are clothed with a young and dense growth of lodgepole pines, but they apparently can not recover a foothold on the upper southwest slope, where they formerly abounded. At no other point in northern Colorado was *Pinus scopulorum* observed above 8,500 feet, and it reaches above 8,000 feet in only a few places. (Pl. VI, fig. 2.)

The Transition zone varies greatly over the State, not only in respect to its vertical and horizontal breadth, but also in its characterization, being sometimes strongly marked and again dilute and ill-defined. It is most uniform in width along the eastern flanks of the front ranges, where the chief irregularities are due to the eastward extending Arkansas Divide and the deeply penetrating valley of the Arkansas River. On the western slope of the Continental Divide the Transition belt is extremely irregular in outline, because of the many plateaus which project westward from the main ranges and the intervening desert valleys. It completely fills the upper valleys and skirts the lower valleys of the Snake, Bear, White, Grand, Gunnison, Dolores, and San Juan Rivers, and their affluents. Two independent arms of the Transition zone enter the State along its northern boundary in the intermountain region—one along the North Platte, a narrow tongue which widens to include practically all the extensive sage plains of North Park at an average elevation of about 8,000 feet; the other, a narrow strip of yellow pine and sage country in the Laramie River region. Two belts of this zone likewise penetrate the intermountain region of Colorado from the south, occupy the foothills of the San Juan and Culebra Ranges, skirt the great San Luis Valley, and connect with the upper Arkansas Transition through a narrow tongue across Poncha Pass.

As already observed, the Transition zone varies greatly in breadth. The variation in horizontal breadth, due entirely to difference in slope incline, is well illustrated by the following examples: On steep slopes such as are found north of Grand River near Glenwood Springs, and between De Beque and Rifle, the aspens of the high Canadian zone country are often less than half a mile from the junipers of the warm Upper Sonoran valley; while on the western side of the Elk Head Mountains, where the slope is very gradual, the Transition zone merges almost insensibly into the Upper Sonoran sage plains, and has a width of 8 or 10 miles or even more. Again, in a few instances, the Transition element is almost lost or crowded out by an unusual upward extension of Upper Sonoran zone. For example, on the north side of the Grand River Valley at McCoy, Eagle County, pinyons and junipers (*Juniperus monosperma*) follow up the warm south slopes to 7,800 feet, while lodgepole pines and aspens clothe the summits and northern slopes at 8,400 feet. The intervening 600 feet, or upper part of the southern slopes, supports a scattering growth of *Pinus scopulorum*, *Pseudotsuga mucronata*, *Amelanchier alnifolia*, *Symphoricarpos oreophilus*, and other Transition species.

Narrow extensions or arms of the Transition zone penetrate the mountains for a considerable distance on both sides of the main ranges, following along the warm north sides of the valleys. Under such conditions the upper limit of the yellow pines is very materially lowered where they penetrate an extensive region of high altitude—that is, the highest elevation at which the pines grow is considerably less at the head of a valley where the surrounding environment is uniformly boreal than on the slopes and ridges near the mouth of the valley, where the bordering high country is much broken and incised and thus permits a more general diffusion of warm air currents. This difference in the upward extension of the pines amounts to nearly 500 feet in the Fountain Creek Valley. In the region about Manitou the upper limit on warm slopes is approximately 9,000 feet, while at Woodland Park, in the upper valley, it is about 8,500 feet.

MAMMALS OF COLORADO TRANSITION.

Both boreal and austral mammals are represented in the Transition zone in Colorado, while only six species appear to be restricted to it. These are two squirrels of the *Sciurus aberti* group, three pocket gophers of the genus *Thomomys*, and a small brown bat, *Myotis lucifugus longicrus*. *Sciurus aberti ferreus* inhabits the eastern foothills of the front ranges from Loveland and Arkins south to the Mosca Pass region, and *Sciurus aberti mimus* occurs in the stately yellow pine forests on the southern slopes of the San Juan and La Plata Mountains. *Thomomys clusius* is found on the sage plains of North Park, on the high grassy plateau in northeastern Weld County, and on the western (higher) end of the Arkansas Divide. *Thomomys talpoides agrestis*, an isolated mountain form of the common *Thomomys talpoides* of the northern plains, is known only from the San Luis Valley meadows. Another gopher, *Thomomys fulvus*, appears to enter the State only on the Raton Mesa, in the Trinidad region. *Myotis l. longicrus* is common in the Transition zone at several points in western Colorado, and appears to be a characteristic zone species.

The following mammals, while not entirely restricted to the Transition zone, have their center of abundance there, and characterize it locally in various parts of the State: The Say chipmunk (*Eutamias quadrivittatus*), in the foothills of the eastern and southern mountains; Wyoming ground squirrel (*Citellus elegans*), on the high sage plains of North Park and in northwestern Colorado; Estes Park cliff mouse (*Peromyscus nasutus*) and Gale wood rat (*Neotoma fallax*), in the eastern foothills of the front ranges; pygmy vole (*Microtus *pauperrimus*), on the higher sage plains of North and Middle Parks and in Routt County; white-tailed jack rabbit (*Lepus campestris*), east of the Continental Divide, from North Park south to the Arkansas Divide, and in San Luis Valley; Townsend jack rabbit (*Lepus campestris townsendi*), of the higher open country west of the Continental Divide; Rocky Mountain cottontail (*Sylvilagus nuttalli pinetis*), mountain coyote (*Canis lestes*), and mountain wildcat (*Lynx uinta*), found throughout the mountainous districts; and the northern plains skunk (*Mephitis hudsonica*), which occurs on both slopes of the northern mountains.

The following mammals of wider zonal range have been found in this zone in various parts of the State:

Mammals Common to Transition and Upper Sonoran.

Antilocapra americana.
Odocoileus virginianus macrourus.
Onychomys brevicaudus.
Castor canadensis frondator.
Canis occidentalis.
Spilogale tenuis.
Eptesicus fuscus.

Mammals Common to Transition and Canadian.

Cervus canadensis.
Callospermophilus lateralis.
Eutamias amœnus operarius.
Eutamias minimus consobrinus.
Erethizon epixanthum.
Microtus nanus.
Microtus pennsylvanicus modestus.
Zapus princeps.
Vulpes macrourus.
Ursus americanus.

Mammals Common to Transition, Canadian, and Upper Sonoran.

Odocoileus hemionus.
Cynomys gunnisoni.
Cynomys leucurus.
Felis oregonensis hippolestes.
Lutreola vison energumenos.
Putorius arizonensis.
Taxidea taxus.

BREEDING BIRDS OF COLORADO TRANSITION.

Birds which breed chiefly in the Transition zone in Colorado are the sage hen (*Centrocercus urophasianus*),[1] saw-whet owl (*Cryptoglaux acadica*), sharp-shinned hawk (*Accipiter velox*), Rocky Mountain hairy woodpecker (*Dryobates villosus monticola*), Lewis woodpecker (*Asyndesmus lewisi*), Wright flycatcher (*Empidonax wrighti*), spurred towhee (*Pipilo maculatus montanus*), green-tailed towhee (*Oreospiza chlorura*), white-throated swift (*Aeronautes melanoleucus*), plumbeous vireo (*Lanivireo solitarius plumbeus*), Macgillivray warbler (*Oporornis tolmiei*), Rocky Mountain nuthatch (*Sitta carolinensis nelsoni*), pygmy nuthatch (*Sitta pygmæa*), and chestnut-backed bluebird (*Sialia mexicana bairdi*).[2] Among the birds occupying restricted areas in the Colorado Transition during the breeding season may be mentioned the Grace warbler (*Dendroica graciæ*), a common breeder in the yellow-pine forests on the southern slopes of the San Juan Mountains.

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[1] Mainly in northwestern Colorado.

[2] Southern Colorado.

Other birds conspicuous during the breeding season in the Transition belt in different parts of the State are:

Bubo virginianus pallescens.
Calamospiza melanocorys.
Colaptes cafer collaris.
Dendragapus obscurus.
Dendroica auduboni.
Euphagus cyanocephalus.
Falco sparverius phalæna.
Myiochanes richardsoni.
Oreoscoptes montanus.
Otocoris alpestris leucolæma.
Passerculus sandwichensis alaudinus.
Penthestes gambeli.
Phalænoptilus nuttalli.
Pica pica hudsonia.
Planesticus migratorius propinquus.
Poœcetes gramineus confinis.
Salpinctes obsoletus.
Sayornis saya.
Sialia currucoides.
Spizella breweri.
Spizella passerina arizonæ.
Sturnella neglecta.
Tachycineta thalassina lepida.
Troglodytes aëdon parkmani.
Vireosylva gilva swainsoni.
Xanthocephalus xanthocephalus.

Several genera of the Anatidæ and at least one genus of the Limicolæ are found on Lake John, North Park, during the summer, and doubtless breed there. These include *Branta canadensis*, *Anas platyrhynchos*, *Spatula clypeata*, *Querquedula discors*, and *Steganopus tricolor*. Other breeders in the same region are the coot (*Fulica americana*) and the great blue heron (*Ardea herodias*).

PLANTS OF COLORADO TRANSITION.

In Colorado, as in most sections of the western United States, the yellow pine (*Pinus scopulorum*) (see Pl. VII, fig. 2) is the characteristic Transition tree, and the zone is practically coextensive with these pines wherever they occur. Their distribution in the Colorado foothills is quite general, except in the northwest, where a very sparse and scattering growth occurs in a few widely separated localities. Over much of western Colorado north of the San Juan Mountains and Uncompahgre Plateau the Transition zone is a partially open region, sage-covered slopes and parks alternating with brushy slopes and ridges of chaparral, including such shrubs as oaks (*Quercus gambeli* (Pl. VII, fig. 1), *Q. fendleri*, and others), chokecherry (*Prunus melanocarpa*), Juneberries (*Amelanchier alnifolia*, *A. bakeri*, and others), and *Ceanothus velutinus*, *Peraphyllum ramosissimum*, *Symphoricarpos oreophilus*, *Kunzia tridentata*, *Cercocarpus parvifolius*, and in the Escalante Hills *Cercocarpus ledifolius*. The most prominent forest tree in the Transition belt of northwestern Colorado is the Douglas spruce (*Pseudotsuga mucronata*), which occurs chiefly on sharp declivities and on the exposed crests of the plateaus above 7,000 feet.

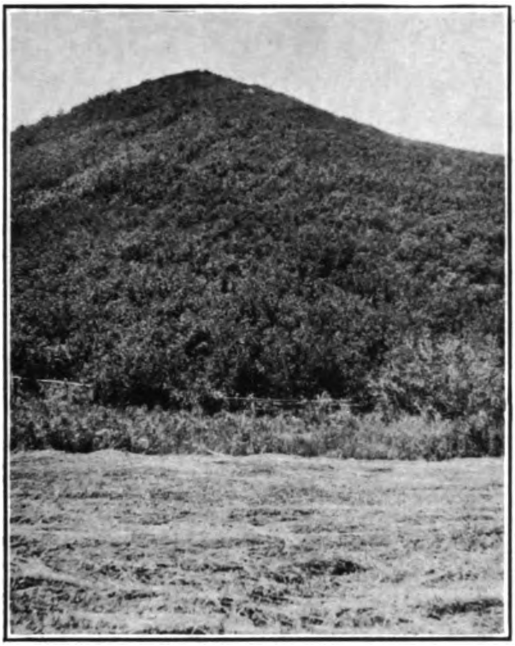

FIG. 1.—DENSE CHAPARRAL OF OAK (QUERCUS GAMBELI) IN WESTERN FOOTHILLS OF WEST ELK MOUNTAINS, ON HEAD OF SMITH FORK OF GUNNISON RIVER, ALTITUDE 8,000 FEET.

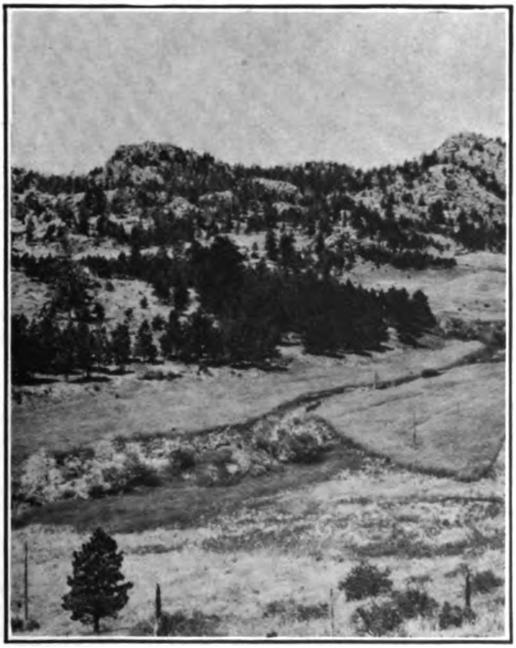

FIG. 2.—YELLOW PINES (PINUS SCOPULORUM) NEAR ELKHORN, LARIMER COUNTY, SHOWING CHARACTERISTIC SCATTERING GROWTH OF THE SPECIES ON EASTERN FOOTHILLS OF FRONT RANGE.

The vegetation of the sage plains of North Park, in addition to *Artemisia tridentata*, consists chiefly of *Sarcobatus vermiculatus* and *Chrysothamnus*, with *Kunzia tridentata* added in sandy strips of country.

Along streams throughout the State this zone is best indicated by the narrow-leaved cottonwood (*Populus angustifolia*). Some of the shrubs found commonly in the neighborhood of streams are the alder (*Alnus tenuifolia*), Rocky Mountain birch (*Betula fontinalis*), dogwood (*Svida stolonifera riparia*), hazel (*Corylus rostrata*), haws (*Cratægus saligna*, *C. wheeleri*, and others), willow (*Salix nuttalli*), *Distegia involucrata*,[1] and *Opulaster ramaleyi*. Another willow (*Salix perrostrata*) grows in dense clumps in bogs and around spring holes. A large variety of shrubs and plants are characteristic of the rocky slopes, among which are several species of June berry (*Amelanchier*), mountain holly (*Cercocarpus parvifolius*),[2] ninebark (*Opulaster monogynus*), flowering raspberry (*Oreobatus deliciosus*), New Jersey tea (*Ceanothus pubescens*), Oregon grape (*Berberis aquifolium*), bearberry (*Arctostaphylos uvaursi*), currants (*Ribes inebrians* and *R. pumilum*), *Kunzia tridentata*, *Edwinia americana*, and *Holodiscus dumosus*. A large species of bearberry (*Arctostaphylos pungens platyphylla*) forms a dense chaparral on the western slopes of the Uncompahgre Plateau and on the opposite (eastern) slopes of the La Sal Mountains, between 8,000 and 8,500 feet. The only cactuses found with any regularity in the Colorado Transition are the little *Opuntia fragilis*, which is common in the yellow pine forests near Pagosa Springs and on the Uncompahgre Plateau, and was found also along the North Fork of the Gunnison River above Somerset; the unique snake cactus (*Echinocactus simpsoni*), most abundant in the Wet Mountain Valley and adjacent region, so called because of the peculiar snake-like growth occasionally formed; and *Echinocereus viridiflorus*, also of the Wet Mountain region. *Cactus missouriensis* occurs occasionally in the yellow pine belt of the eastern foothills. *Chrysothamnus elegans*, *C. bigelovi*, and several other species of rabbit brush are common and characteristic shrubs in the Wet Mountain Valley and in all the open valleys and parks between 7,000 and 9,000 feet.

REPTILES AND BATRACHIANS OF COLORADO TRANSITION.

A few reptiles occur with more or less regularity in the Transition zone, but it is doubtful whether any are restricted to it. Among the lizards, the large gray rock lizard (*Sceloporus elongatus*)[3] is found in rocky situations along the lower edge of the zone in many parts of western and southwestern Colorado. One of the whip-tailed lizards,

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[1] Also lower Canadian. [2] Also Upper Sonoran. [3] Most abundant in Upper Sonoran zone.

(*Cnemidophorus gularis*)[1] seen in the foothills near Golden in June, 1905, was in a rank growth of grass on a yellow pine slope, at 6,500 feet. Horned toads (*Phrynosoma ornatissimum*) are tolerably common in the sandy yellow pine country on the northern end of the Uncompahgre Plateau. In July, 1907, several were seen on the head of Dominguez Creek, at 8,500 feet, and one individual was collected. Another, not over a third grown, was taken in late September, 1906, at the same elevation on the chaparral-covered summit of the Book Cliffs at Baxter Pass near the Utah boundary. A garter snake (*Thamnophis elegans vagrans*)[2] is not uncommon in the pine belt and is found also in the lake region of North Park. A specimen taken at Higho, North Park, in August, 1906, was crawling through the sagebrush at some distance from water. Another was collected along Snake River east of Slater, Routt County, in August, 1906, at a little over 7,000 feet. The little green snake (*Liopeltis vernalis*) was taken but once, on the bank of the Rio Piños, a few miles below Vallecito, June 6, 1907. A small frog (*Chorophilus triseriatus*) was secured on Snake River, about 10 miles east of Slater, August 21, 1906. Edward A. Preble collected the larva of a salamander (*Ambystoma tigrinum*) in Estes Park in 1895.

AGRICULTURAL IMPORTANCE OF THE TRANSITION ZONE.

The rough and broken character of much of the Transition area in Colorado precludes agriculture on an extensive scale, although the climatic conditions are favorable for many of the hardier vegetables, cereals, and fruits. The most important of its natural resources are the yellow pine forests, which in some localities are very extensive. The few areas of any size which are sufficiently open for cultivation are North Park, the Wet Mountain Valley, San Luis Valley, and the western (higher) end of the Arkansas Divide, together with certain of the larger foothill valleys. Of these, the first two are devoted largely to ranching and hay raising, the Arkansas Divide to grazing, and the San Luis Valley alone to extensive agriculture. Wheat, oats, and rye are the leading cereals raised in the Colorado Transition, while timothy is an important hay crop. A great deal of alfalfa is grown along the lower edge of the zone, where it usually yields two cuttings. Higher up it is not a success. Potatoes and Canada field peas are important crops in the San Luis Valley. A great variety of vegetables are grown in the San Luis Valley, and also in the stream valleys of the higher foothills over the State, where a good market is furnished by the neighboring mining camps. Comparatively little fruit is raised, but with a proper selection of hardy varieties horticulture might be made an important industry in the protected foothill

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[1] Most abundant in Upper Sonoran zone.

[2] Also in lower Canadian zone.

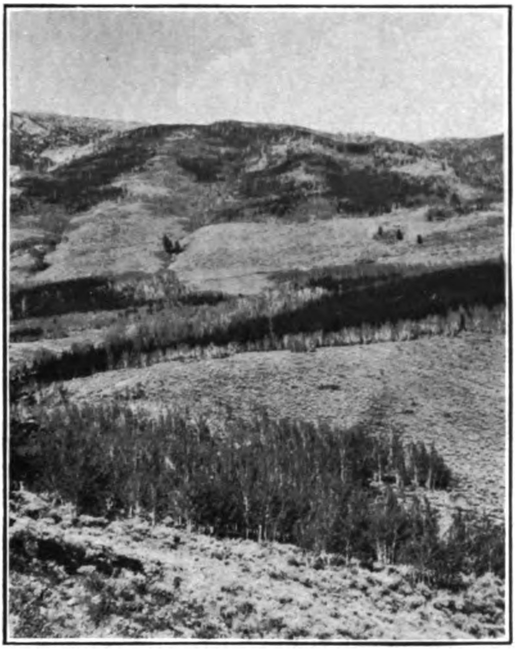

FIG. 1.—LOWER PART OF CANADIAN ZONE FOREST OF LODGEPOLE PINES (PINUS MURRAYANA) AND ASPENS (POPULUS TREMULOIDES) ON NORTH PARK SLOPE OF MEDICINE BOW RANGE.

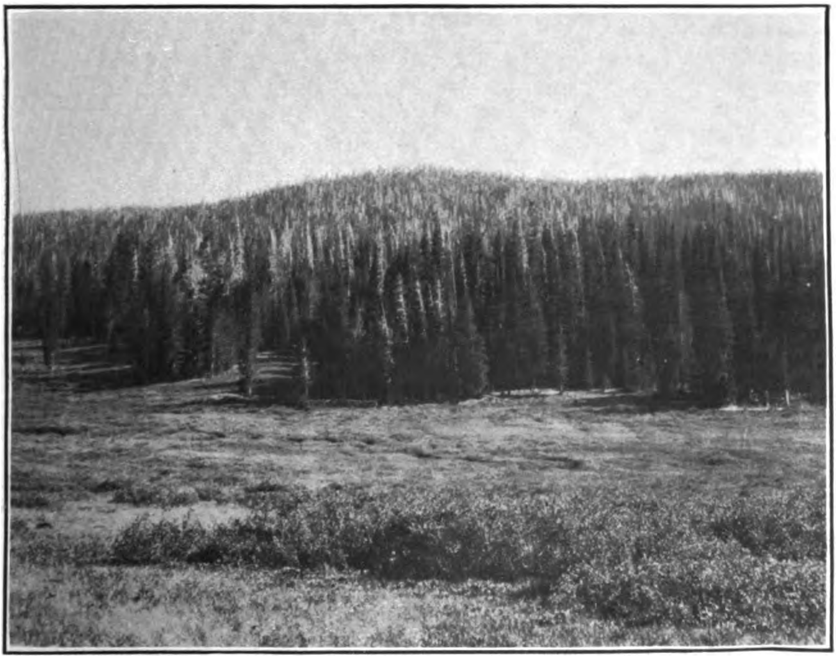

FIG. 2.—FOREST OF ENGELMANN SPRUCE (PICEA ENGELMANNI) IN UPPER PART OF CANADIAN ZONE, ON SUMMIT OF PARK RANGE, AT 10,000 FEET.

valleys wherever water is available for irrigation. A variety of berry fruits, such as June berries, strawberries, raspberries, currants, and gooseberries, are native to the Transition zone in Colorado.

The Transition zone is suited to the growth of practically all the vegetables, including the cabbage, lettuce, turnip, radish, potato, beet (both table and sugar), pea, bean, onion, carrot, parsnip, and early sweet corn; all hardy cereals; and the hardier varieties of apples, cherries, and small fruits. The crab apple reaches its best development in this zone.[1]

CANADIAN ZONE.

This, the more extensive of the boreal zones, occupies the middle slopes on the main ranges and extensive areas in the mountain parks, and caps all of the higher western plateaus, thus including the larger part of the coniferous forests of the State. Broadly speaking, the Canadian zone is characterized in the mountains of Colorado by extensive forest belts of aspens (*Populus tremuloides*), lodgepole pines (*Pinus murrayana*), and the lower, heaviest part of the Engelmann spruce belt (see Pl. VIII, fig. 2). White firs (*Abies concolor*) are added to these in the southern mountains. On the western plateaus it is marked by either a mixed forest of aspens and Engelmann spruces, or else a partially open country of grassy parks and aspen groves. In the park region of central Colorado considerable areas of open grass land are in this zone.

Chief among the elevated areas in western Colorado extensively capped with Canadian zone are the White River, Book, and Uncompahgre Plateaus; Grand, Battlement, Lone, and Blue Mesas; the Danforth and Huntsmans Hills; and the Cathedral Bluffs. The Gore, Elk Head, Rabbit Ear, Williams River, and West Elk Mountains are largely or wholly Canadian, while perhaps the largest areas of this zone are found in the Middle, Egeria, and South Park regions. Small Canadian zone islands cap the summits and upper northern slopes of many small outlying peaks and plateaus, especially in western and southern Colorado. Among these may be mentioned Diamond and Zenobia Peaks, Mount Cullom, and Yampa and O-wi-yu-kuts Plateaus, all in extreme western Routt County; Ute Peak, the highest point in the Sierra el Late, in Montezuma County; isolated table mountains south of the San Miguel and San Juan Mountains, and peaks between the upper forks of the South Platte; and Raton Mesa, southeast of Trinidad.

In the mountains of the northern half of the State the lodgepole pine and aspen forests are regularly entered at between 7,500 and 8,000 feet, and continue up to a little over 10,000 feet. (See Pl.

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[1] Some of the varieties of cereals and fruits which have proved adapted to the Transition zone (arid subdivision) in Idaho, eastern Washington, and Utah, are listed by Merriam in Life Zones and Crop Zones, Bull. No. 10, Biological Survey, pp. 25-27, 1898.

VIII, fig. 1.) Passing south to the latitude of Colorado Springs, the Canadian zone level is raised 500 to 1,000 feet, and continues high over most of the southern mountains, with the vertical breadth about as in the north. The vertical boundaries are subject to great local variation, according to physiographic conditions, entirely apart from the regular elevation and depression due to slope exposure. Striking examples are the upper Arkansas Valley and Gunnison regions, on opposite sides of the Continental Divide. On the mountain slopes bordering the upper Arkansas from the Royal Gorge to Buena Vista and beyond, Canadian zone species are seldom encountered much below 8,500 or 9,000 feet, even on cold exposures, and along the east side of the valley in the vicinity of Trout Creek Pass they are crowded on warm slopes above 9,500 feet. Over much of the upper Gunnison country lodgepole pines and aspens grow regularly as low as 8,000 feet on cold exposures and 8,500 feet on warmer slopes. The comparatively low elevation reached in the Gunnison country is undoubtedly due to the influence of the great mass of boreal country which practically surrounds the region. The unusually high temperature and consequent high zone levels which prevail in the upper Arkansas region are probably due to several factors. The southward trend of this narrow valley admits the hottest rays of the sun, which shine with great directness upon very abrupt bordering slopes; while the region to the east and south is neither so high nor so extensively boreal as that which surrounds the Gunnison country. The western slopes of the Sangre de Cristo Range and the eastern slopes of the Cochetopa Hills and Garita Mountains, bordering the northern two-thirds of the San Luis Valley, and the eastern slopes of the Sangre de Cristo Range near Mosca and Sand Hill Passes, are other notable examples of abnormally high zone levels, where on warm slopes the Canadian element is often forced above 9,500 feet. This is probably the result of the high, 7,500-foot base level of San Luis Valley. South from Mosca Pass along the eastern slope of the range the lower boundary of the Canadian zone gradually drops to about 8,000 feet, which level is uniformly maintained on the slopes of the high Culebra Range west of Trinidad. The low 6,000-foot base level of the Trinidad plains would account for low zone levels on the Culebras.

The effect of slope exposure on zone level is well shown along the lower edge of the Canadian zone, both on individual slopes and on opposite sides of mountain ranges, especially on those which rise abruptly with few flanking foothills. On the high narrow Sangre de Cristo Range the difference in mean elevation between the east and west slopes amounts to fully 500 feet, and it is nearly as great on some of the other ranges. Throughout the mountains, cool shaded north and northeast slopes and gulches carry the aspens, lodgepole

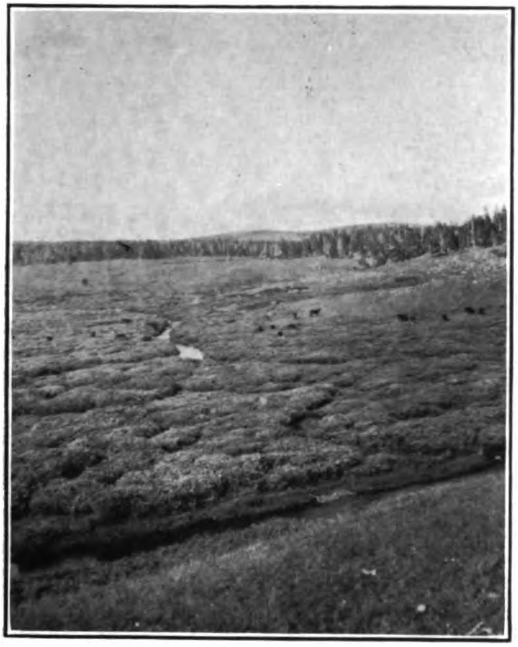


FIG. 1.—SUMMER CATTLE RANGE, CANADIAN ZONE MEADOW EAST OF LARAMIE RIVER, 10,000 FEET ALTITUDE.

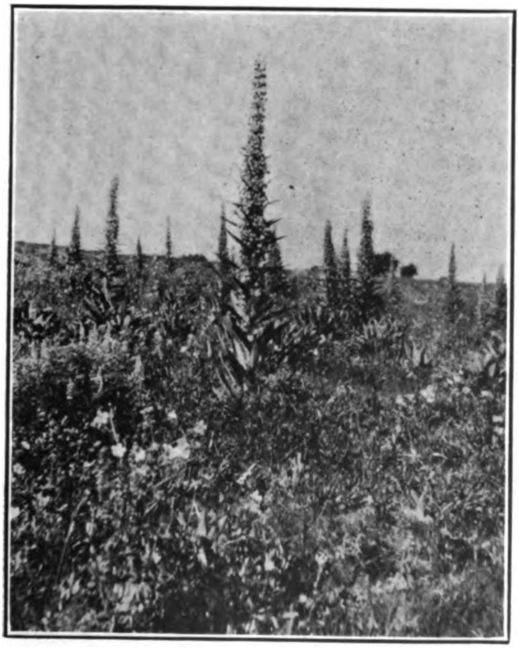


FIG. 2.—CANADIAN ZONE VEGETATION AT 9,000 FEET ON OPEN SUMMIT OF UNCOMPAHGRE PLATEAU—FRASERA, DELPHINIUM, GERANIUM, AND LUPINUS.

pines, firs, and other Canadian zone vegetation to a low elevation. Some of the cold streams on the eastern slope of the Front Range carry quite pronounced tongues of Canadian zone as low as 7,000 feet. These consist of thickets of aspens, a scattering fringe of blue spruces (*Picea parryana*), and occasionally an Engelmann spruce. These descending boreal tongues are invariably embraced by warm slopes clothed in different parts of the State with yellow pines, oaks, sagebrush, and other Transition zone vegetation. At Honnold, Routt County, lodgepole pines and dense thickets of scrubby aspens crowd down the steep northern faces of the Elk Head Mountains to the bank of Snake River, at 7,000 feet, alternating with ascending tongues of sagebrush (*Artemisia tridentata*) on all the warm Transition slopes up to 7,500 or even 8,000 feet.

The boreal forest belts are best shown on sharply inclined slopes, like the steep north side of the Clear Creek Valley between Silver Plume and Graymont, where in summer a beautiful tricolored appearance is presented, due to the three shades of green of the aspen, lodgepole pine, and Engelmann spruce forest. The slopes up to 10,500 feet are densely clothed with the first two trees in about equal abundance, and present a patched appearance, thickets and ascending tongues of the light-green aspens being scattered through the more uniformly distributed, dark, yellowish-green pines. (See Pl. VIII, fig. 1.) Joining the upper edge of this forest is a regular and well-marked belt of greenish-black Engelmann spruces, while still higher up the slope may be seen the straggling growth of foxtail pines (*Pinus aristata*) of the timberline region—of the same hue as the Engelmann spruces, but distinguishable by their ragged appearance.

In Colorado extensive forests cover a very large percentage of the total area occupied by the Canadian zone, which is poorly adapted to crops. The only open land at all suited to agriculture is found along the lower edge, between 8,000 and 9,000 feet, and comprises narrow strips along the streams in the larger mountain valleys and parks and on the western plateaus. At present this agricultural land is largely utilized for wild hay and timothy. As most of the park and plateau region supports a luxuriant growth of grasses, affording an excellent summer range for cattle (see Pl. IX, fig. 1), there would probably be no economic advantage in cultivating the hardy cereals grown in the warmer part of this zone in various sections of the United States and Canada. A very limited acreage of rye, oats, and wheat is grown in Middle Park and elsewhere in the mountains, but as yet their culture is scarcely beyond the experimental stage. The hardier vegetables also, as beets, parsnips, lettuce, turnips, potatoes, cabbages, and carrots, are raised successfully along the lower edge of the zone. The fact that wild strawberries, raspberries, currants, and blueberries grow in profusion in this zone strongly suggests that cultivated varieties might do well in favored spots. The roughness of much of the region in this zone precludes the possibility of extensive agriculture even under favorable climatic conditions. The chief resource of the Canadian zone, however, is its timber, especially the extensive forests of lodgepole pines. On some of the northern mountains, as the Park and Medicine Bow Ranges, where mining operations have made the least inroad on the forests, these pines grow very closely and to maximum size, many of the trees reaching a diameter of 2 feet or more. With their remarkably uniform straight growth and close stand, these pines form a beautiful and stately forest and yield valuable lumber. (See fig. 31.)

MAMMALS OF COLORADO CANADIAN ZONE.

The following boreal mammals have their center of abundance in the Canadian zone of Colorado, and rarely range much lower, although most of them extend up into the Hudsonian zone: Fremont chickaree (*Sciurus fremonti*), woodchuck (*Marmota engelhardti*), Rocky Mountain red-backed mouse (*Evotomys gapperi galei*), Preble phenacomys (*Phenacomys preblei*), mountain phenacomys (*Phenacomys orophilus*), Rocky Mountain field mouse (*Microtus mordax*), tawny white-footed mouse (*Peromyscus maniculatus rufinus*), snowshoe rabbit (*Lepus bairdi*), Colorado pocket gopher (*Thomomys fossor*), black bear (*Ursus americanus*), western fox (*Vulpes macrourus*), Rocky Mountain jumping mouse (*Zapus princeps*), dwarf weasel (*Putorius streatori leptus*), Canada lynx (*Lynx canadensis*), marten (*Mustela caurina origenes*), wolverine (*Gulo luscus*), shrews (*Sorex vagrans dobsoni*, *S. tenellus nanus*, *S. obscurus*, and *S. personatus*), water shrew (*Neosorex palustris navigator*), and silver-haired bat (*Lasionycteris noctivagans*).

BREEDING BIRDS OF COLORADO CANADIAN ZONE.

The following birds appear to be very commonly found in the Canadian zone in Colorado during the breeding season: Rocky Mountain jay (*Perisoreus canadensis capitalis*), olive-sided flycatcher (*Nuttallornis borealis*), Alpine three-toed woodpecker (*Picoides americanus dorsalis*), Lincoln sparrow (*Melospiza lincolni*), *Dendragapus obscurus*, *Cyanocitta stelleri diademata*, *Loxia curvirostra minor*, *Sphyrapicus thyroideus*, *S. varius nuchalis*, *Spinus pinus*, *Junco phæonotus caniceps*, *Iridoprocne bicolor*, *Sitta canadensis*, *Cinclus mexicanus unicolor*, *Myadestes townsendi*, *Hylocichla guttata auduboni*, *Dendroica auduboni*, and *Carpodacus cassini*. Some of the above species breed more or less commonly from the foothill region nearly to timberline, but their center of abundance during the breeding season is in the Canadian zone, between 8,000 and 10,000 feet.

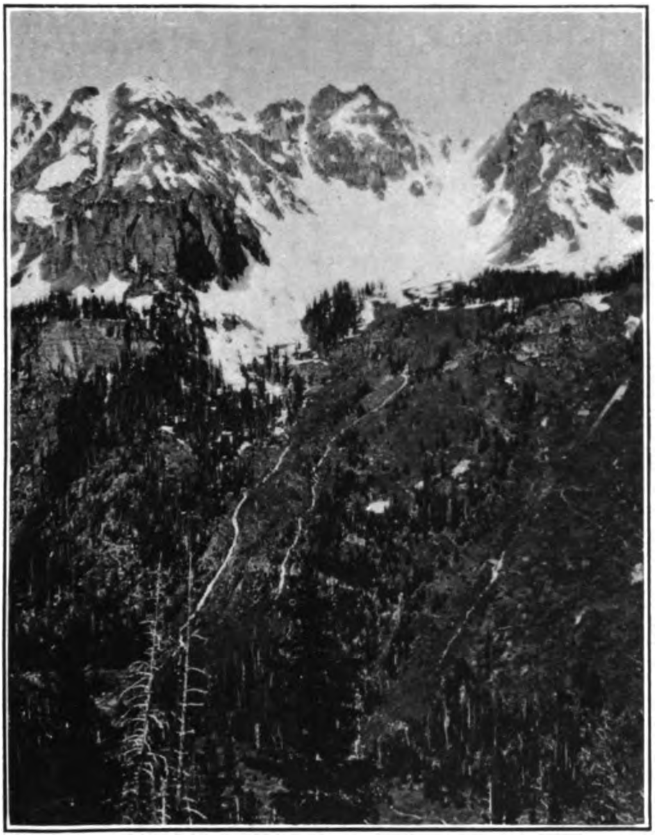
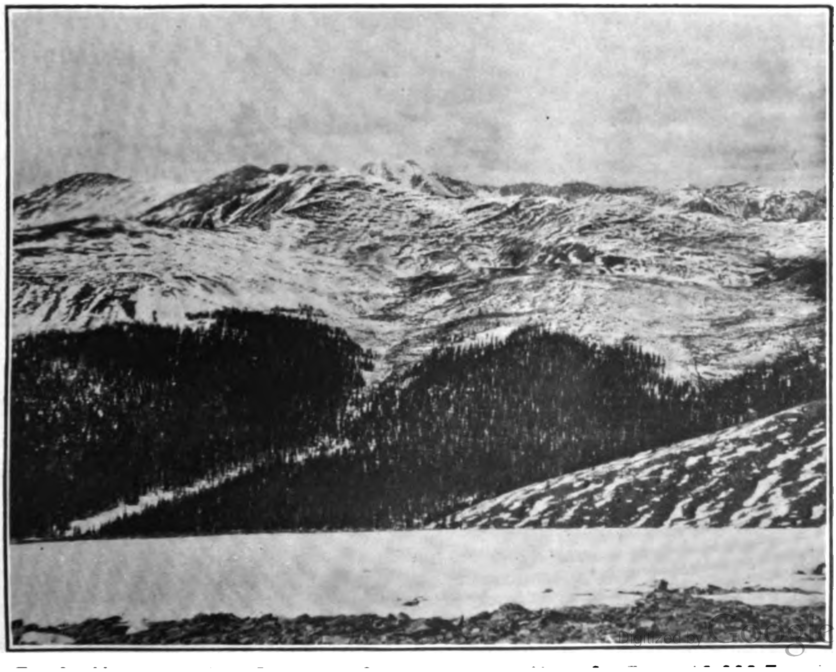


FIG. 1.—HUDSONIAN ZONE, SAN JUAN MOUNTAINS, SOUTHWEST OF OPHIR.



PLANTS OF COLORADO CANADIAN ZONE.

The coniferous forest of the Canadian zone is composed chiefly of lodgepole pines in the northern two-thirds of the State and of white firs in the southern third; but it includes also the heaviest and lowest part of the Engelmann spruce belt and a scattering growth of balsam firs (*Abies lasiocarpa*) along its upper edge; and in the lower third a fringe of blue spruce along the streams, more or less Rocky Mountain white pine (*Pinus flexilis*), especially in the southern mountains, and an admixture of Douglas spruce along its lower edge throughout the State. The aspen (*Populus tremuloides*) marks this zone in all the mountainous sections.

The most characteristic shrubs and plants are the Canadian buffalo berry (*Lepargyrea canadensis*) on dry slopes, chiefly of the Front, Park, and Saguache Ranges; alder (*Alnus tenuifolia*), and willows (*Salix geyeriana* and others), which fringe the cold streams and bogs between 10,000 and 11,000 feet; elderberries (*Sambucus melanocarpa* and *S. microbotrys*); blueberry (*Vaccinium caespitosum*); currant (*Ribes wolfi*); mountain juniper (*Juniperus sibirica*); mountain maple (*Acer glabrum*); columbine (*Aquilegia cærulea*); twinflower (*Linnæa americana*); *Pachystima myrsinites; Rubacer parviflorus; Viburnum pauciflorum; Viola canadensis neomexicana; Frasera speciosa* (see Pl. IX, fig. 2); *Cytherea bulbosa; Actæa viridiflora; Dasiphora fruticosa; Rosa manca;* and several species of *Pyrola, Epilobium, Castilleja,* and *Delphinium.* The little dwarf birch (*Betula glandulosa*) forms a conspicuous fringe along cold streams and bogs in the upper part of the zone in many of the mountain ranges.

REPTILES OF COLORADO CANADIAN ZONE.

The only reptile observed in this zone is a garter snake (*Thamnophis elegans vagrans*), collected in a cold bog near Pearl, North Park, in August, 1906, at an altitude of a little over 8,000 feet. It is not known, however, that this snake occurs regularly in the Canadian zone. It is not uncommon over the State in the Transition zone.

HUDSONIAN ZONE.

On all the higher mountains of Colorado a dark, somber-colored forest belt of varying width is prominent just below timberline. Traced along the upper slopes of the main ranges this belt is seen to be heaviest and broadest in gulches and basins, while on jutting shoulders and exposed ridges of steep incline it often contracts to a narrow black line. (See Pl. X, fig. 1.) This is the upper forest of Engelmann spruce (*Picea engelmanni*) and balsam fir (*Abies lasiocarpa*), and marks in a general way the limits of the Hudsonian zone. It is a neutral or transition area combining both Arctic-Alpine and Canadian zone elements. Very few species are restricted to it, and it is therefore not so well characterized as either bordering zone.

Especially is this lack of character manifest along the lower edge of the zone, where in the heavy forests on slopes of moderate incline Hudsonian conditions merge almost insensibly into those of the Canadian zone. Well-defined belts of the Hudsonian zone are found only on such mountain ranges as are sufficiently high to afford alpine conditions on their summits and highest spurs, as the Front, Park, Saguache (see Pl. X, fig. 2) and Sangre de Cristo Ranges, and the San Juan Mountains. The lower stretches of the above ranges and many connecting and outlying mountains with a near approach to timberline conditions on their highest elevations are capped with this zone. In dilute form it may be traced also along the crests of some of the outlying ridges and spurs which do not reach timberline.

The vertical width of the Hudsonian zone on the Colorado mountains is not far from 1,000 feet. It narrows to 600 feet in places, and again widens to as much as 1,200 feet, and in extreme cases to 1,500 feet. The lower boundary is seldom clearly defined, being usually on steep slopes at between 10,500 feet and 10,800 feet on warm exposures, and several hundred feet lower on cool slopes and especially in gulches. The upper part of the Hudsonian belt is well indicated by timberline conditions. On normal warm slopes the spruces and firs begin to dwarf at a little over 11,000 feet. They rapidly become stunted and much dwarfed, then semiprostrate, and finally as dense prostrate mats from 1 to 3 feet in height and often many feet in diameter, crowd far up the exposed ridges in narrow ascending tongues, giving place to the bare Alpine slopes at a mean elevation of about 11,500 feet, but on the warmest slopes from 11,800 feet to 12,300 feet.

The upper limit of this zone (timberline) is the best marked of all zonal boundaries. It is very sinuous, and affords perhaps the most striking example of one zone lapping past another. Traced along the upper slopes of a mountain range, it is seen regularly to dip down several hundred feet to skirt the lower edges of basins and gulches occupied by descending arms of the Arctic-Alpine zone; and again to reach far above its normal elevation on the exposed crests of the bordering ridges. In this manner tongues of Arctic-Alpine and Hudsonian zone regularly lap past each other at timberline for a vertical distance of 400 or 500 feet and in extreme cases for twice that distance, or about the width of the zone. (See Pl. XI, fig. 2.)

The following are a few of the limits of the Hudsonian zone in different parts of the State that will serve to illustrate the range of variation as to vertical position: Rollins Pass, Front Range (east slope), 10,000 to 10,900 feet; near Fremont Pass (east slope), 11,000 to 11,600 feet; St. Elmo, Saguache Range (southwest slope), 10,800 to 12,300 feet; Ophir, San Juan Mountains (north slope), 10,500 to 11,500 feet; Continental Divide, southeast of Lake City (northwest slope), 10,800 to 12,000 feet.

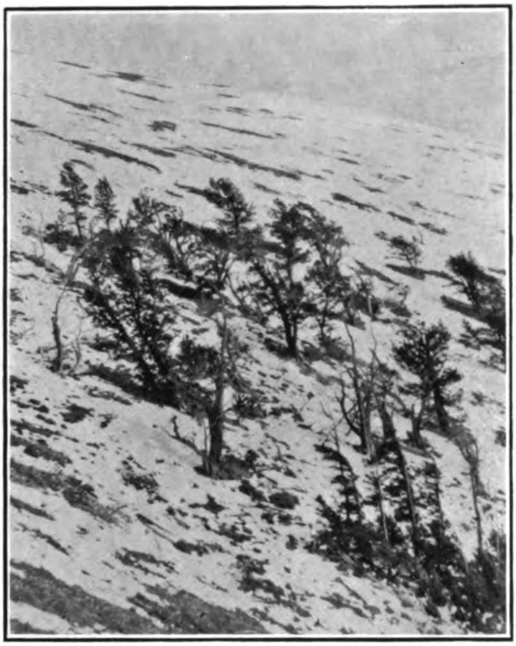


FIG. 1.—FOXTAIL PINES (PINUS ARISTATA) AT TIMBERLINE NEAR ST. ELMO, SAGUACHE MOUNTAINS, AT 12,300 FEET.

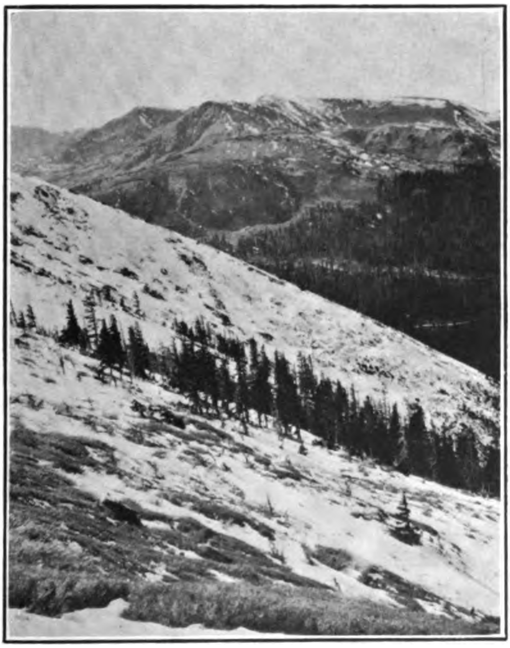


FIG. 2.—ASCENDING TONGUE OF ENGELMANN SPRUCE AT TIMBERLINE ON FRONT RANGE NEAR BERTHOUD PASS (NORTHWEST SLOPE), AT 11,600 FEET.

The Engelmann spruce predominates in the Hudsonian forest belt throughout Colorado, and in certain sections is the only tree present. Usually, however, thickets of balsam fir are scattered through the spruce forest in bogs and on cool slopes, and occasionally the firs form a dense growth, as on the eastern slope of the Front Range in the vicinity of Rollins Pass, on the western slope of the same range above Arrow and Idlewild, and west of Alpine Pass on the Saguache Range. Both the spruce and fir extend up to extreme timberline. They reach their maximum size, and the former its densest growth, along the upper edge of the Canadian zone. Above 11,000 feet dwarfed growth is the rule, but there are marked exceptions. In crossing the two high ridges which form the divide between the Lake Fork of the Gunnison and Cebolla Creek, southeast of Lake City, at elevations of 11,350 and 11,550 feet, respectively, I found the spruce belt continuous and heavy, the trees averaging from 60 to 80 feet in height. On a southwest slope in the Saguache Mountains north of St. Elmo, at an altitude of 11,700 feet, Engelmann spruces were growing commonly to a height of 30 or 40 feet.

On the Front Range south of James Peak, throughout the length of the Saguache Range, and on the Sangre de Cristo Range south at least to Crestone Peak, another tree occupies much of the timberline region to the partial exclusion of the spruce and fir This is the foxtail pine (*Pinus aristata*), which crowds up the warm sides and along the crests of exposed gravelly ridges in a ragged, one-sided, wind-beaten growth from 5 to 15 feet in height. This pine appears to be local in its distribution, being present on some mountains and entirely absent on neighboring peaks of the same range. It is largely confined to the front ranges south of the latitude of Denver and was not noted on the mountains of western and extreme northern Colorado. It is the characteristic timberline tree on the mountains bordering South Park on the west, and also on that part of the Saguache Range known as the University Range—from Salida north to Buena Vista. Warm south and southwest slopes are chiefly occupied by the foxtail pines. Timberline on the cool sides of the mountains is usually formed by spruces and firs. But at St. Elmo, where foxtail pines form the highest recorded timberline in the State (12,300 feet), the gnarled and twisted, often nearly prostrate, trunks of the uppermost of these evidence in a most striking manner the stern contest for existence waged against a rigorous and adverse climate. (See Pl. XI, fig. 1.)

Although characteristic of the Hudsonian zone, the Engelmann spruce, balsam fir, and foxtail pine are by no means restricted to it. The spruce forms regularly a heavy growth and the fir a scattering growth along the upper edge of the Canadian zone, while the pine occurs sparingly on exposed gravelly points and ridges as low as 9,500 feet, particularly in the South Park region.

The mossy floor of the Hudsonian forest is saturated with moisture throughout the summer from the melting snows of the higher slopes, and cold bogs abound. Flowering plants grow in profusion, although the number of species is not large—the flora being mostly a mixture of overlapping Arctic-Alpine and Canadian zone species.

The Hudsonian and Arctic-Alpine regions are not only the sources, but also the conservers, of much of the water supply, so vitally essential to successful agriculture throughout the State, and the importance of the regions in this regard can scarcely be overestimated. The forests of Engelmann spruce and balsam fir, although yielding lumber of very inferior quality, are used extensively for mining timbers in the higher mountains.

MAMMALS OF COLORADO HUDSONIAN ZONE.

Among mammals, no species appears to be restricted to the Hudsonian, but the pika, marmot, and mountain sheep are characteristic of the timberline region.

The following are found in greater or less abundance, as either residents or stragglers:

Callospermophilus lateralis.
Canis lestes.
Cervus canadensis.
Erethizon epixanthum.
Eutamias amœnus operarius.
Eutamias minimus consobrinus.
Evotomys gapperi galei.
Felis oregonensis hippolestes.
Gulo luscus.
Lepus bairdi.
Lepus campestris townsendi.
Lynx canadensis.
Lynx uinta.
Marmota engelhardti.
Microtus mordax.
Microtus nanus.
Mustela caurina origenes.
Neotoma cinerea orolestes.
Ochotona saxatilis.
Odocoileus hemionus.
Ovis canadensis.
Peromyscus maniculatus rufinus.
Putorius arizonensis.
Putorius streatori leptus.
Sciurus fremonti.
Sorex obscurus.
Thomomys fossor.
Ursus americanus.
Ursus horribilis.
Vulpes macrourus.

BREEDING BIRDS OF COLORADO HUDSONIAN ZONE.

The following birds are restricted mainly in their breeding range to the Hudsonian zone: *Pinicola enucleator montana*, *Certhia familiaris montana*, and *Regulus satrapa*.

The following birds occur commonly in summer in Hudsonian and Canadian zones, some of them breeding early in a lower zone:

Picoides americanus dorsalis.
Nucifraga columbiana.
Perisoreus canadensis capitalis.
Myadestes townsendi.
Zonotrichia leucophrys.
Junco phæonotus caniceps.
Spinus pinus.
Wilsonia pusilla pileolata.
Regulus calendula.
Hylocichla guttata auduboni.
Planesticus migratorius propinquus.
Sialia currucoides.
Colaptes cafer collaris.

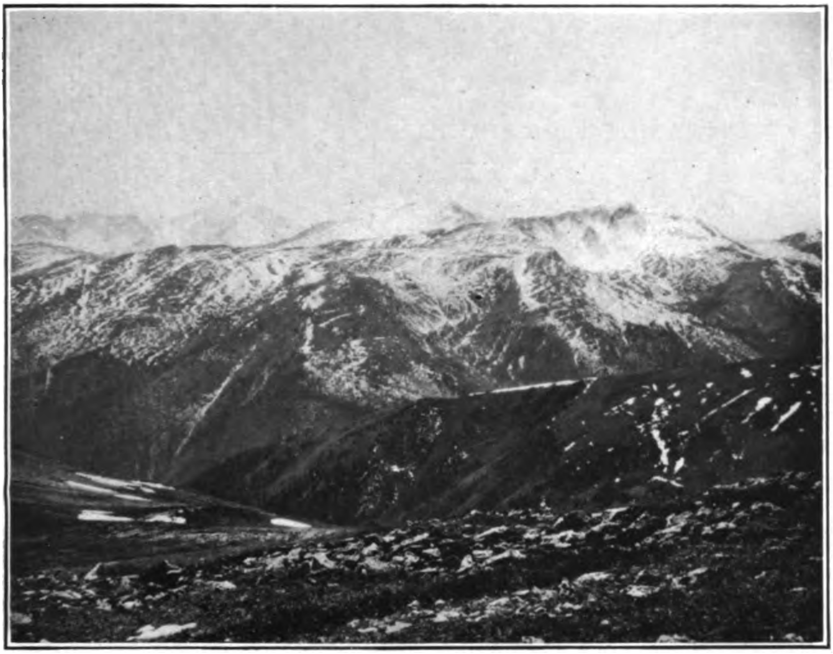


FIG. 1.—GRAYS PEAK GROUP FROM NEAR BERTHOUD PASS, SHOWING AN EXTENSIVE AREA OF ARCTIC-ALPINE COUNTRY.

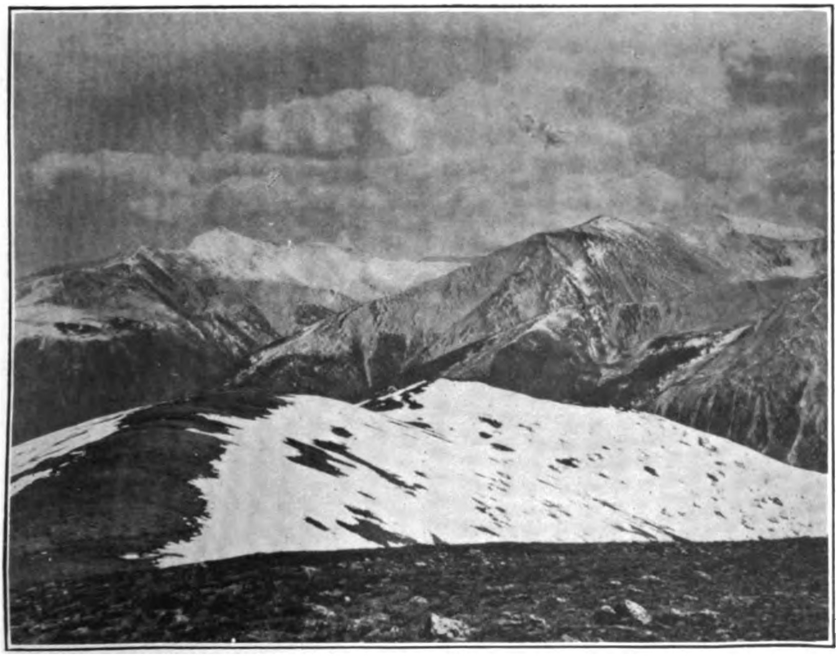


FIG. 2.—ARCTIC-ALPINE ZONE ON THE SAGUACHE RANGE NEAR ST. ELMO.

PLANTS OF COLORADO HUDSONIAN ZONE.

The distribution of the Engelmann spruce (*Picea engelmanni*), balsam fir (*Abies lasiocarpa*), and foxtail pine (*Pinus aristata*) in the Hudsonian zone has already been discussed in detail. Conspicuous plants and shrubs of the timberline region are: *Caltha leptosepala*, *Trollius albiflorus*, *Ranunculus unguiculatus*, *Erysimum radicum*, *Sedum stenopetalum*, *Polemonium* (several species), *Trifolium* (several species), *Androsace* (several species), *Clementsia rhodantha*, *Rhodiola polygama* and *R. integrifolia*, *Mertensia alpina* and other species, *Epilobium*, *Vaccinium erythrococcum*, *Kalmia microphylla*, *Betula glandulosa*, *Salix glaucops*, *S. pseudolapponum*, *S. chlorophylla*, and *S. saximontana*.

ARCTIC-ALPINE ZONE.

Truly arctic conditions characterize this zone, which occupies the summits of the highest peaks and the crests of all the higher mountains above the limit of tree growth. Small areas are found on the Park Range from Buck Mountain and Mount Zirkel south nearly to Buffalo Pass; on the southern half of the Medicine Bow Range; on the higher eastern end of the Rabbit Ear Mountains; and on the Vasquez, Williams, and Gore Mountains of the Middle Park region. A belt which is continuous, or at most is broken only by narrow gaps dipping to timberline or a trifle below, extends from Longs Peak south along the crest of the Front Range to Gray's Peak (see Pl. XII, fig. 1) and the Leadville region. Extensive areas of the Arctic-Alpine zone are found on the mountains of southern Colorado, especially on the San Juan Mountains, and on the Saguache (see Pl. XII, fig. 2), Sangre de Cristo, and Culebra Ranges. The La Plata, San Miguel, Elk, Tarryall, and Wet Mountains, and the Kenosha Range all have many summits reaching far above timberline. Small islands of the Arctic-Alpine zone also cap many of the more or less isolated peaks of the Gunnison country, Pikes Peak, and a few of the highest elevations at the eastern end of the White River Plateau known collectively as the Flat Top Peaks.

The altitude of extreme timberline, which marks the lower boundary of the Arctic-Alpine zone, varies over the State according to slope, exposure, and latitude from a trifle under 11,000 feet to 12,300 feet. It is lowest in the northern mountains and in the San Juans,[1] where the mean elevation is 11,500 feet and the extremes are 10,900 feet (east side of Rollins Pass and south of Ophir), and 11,800 feet (mountains southeast of Lake City); and highest on the Front and Saguache Ranges west of South Park and the Arkansas Valley, with a mean elevation of nearly 11,800 feet, and extremes of 11,000 feet and 12,300 feet (north of St. Elmo). Under normal conditions the Arctic-Alpine zone usually dips lowest in basins and gulches with northeast exposures, where it is often embraced for 500 feet or more by ascending tongues of the Hudsonian zone, which follow up the bordering ridges. The exceptional cases, where timberline is lowest on west or southwest slopes, will usually be found to be due to unnatural conditions. Thus at Boreas Pass, in the mountains west of South Park, timberline is below 11,600 feet on a southwest slope of slide rock, while on the northeast slope opposite, with favorable soil conditions, it reaches 11,900 or 12,000 feet. In approximating the elevation of normal timberline due allowance must always be made for the effects of rock slides and avalanches, which, viewed from a distance, appear to be descending tongues of Arctic-Alpine zone reaching far below timberline. These slides, by carrying away the soil and leaving in its place great masses of slide rock, create conditions unsuitable for tree growth, yet do not remove the climatic barrier which prevents the downward dispersion of Alpine species.

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[1] The reason for the low average timberline elevations in the San Juan Mountains is the lowness of the base level (5,000 feet), where their latitude and their proximity to a hot desert region on the west would lead us to expect a high timberline.

The Arctic-Alpine area is a bare and bleak region covered with snow for the greater part of the year, and with more or less remaining on the ground in summer. Naturally the variety of life is here reduced to a minimum.

MAMMALS OF COLORADO ARCTIC-ALPINE ZONE.

No mammals are restricted to the Arctic-Alpine area in Colorado. The following species range at times to considerably above timberline in different parts of the mountains: Mountain sheep (*Ovis canadensis*), grizzly bear (*Ursus horribilis*), coyote (*Canis lestes*), marten (*Mustela caurina origenes*), western fox (*Vulpes macrourus*), porcupine (*Erethizon epixanthum*), snowshoe rabbit (*Lepus bairdi*), two chipmunks (*Eutamias amœnus operarius* and *E. minimus consobrinus*), marmot (*Marmota engelhardti*), Colorado pocket gopher (*Thomomys fossor*), pika (*Ochotona saxatilis*), and two field mice (*Microtus mordax* and *M. nanus*). Of these the marmot, pika, pocket gopher, and field mice apparently live in this bleak region throughout the year.

BREEDING BIRDS OF COLORADO ARCTIC-ALPINE ZONE.

Three species of birds are restricted to the Alpine zone during the breeding season. These are the white-tailed ptarmigan (*Lagopus leucurus*), the pipit (*Anthus rubescens*), and the brown-capped rosy finch (*Leucosticte australis*), none of which are known to breed much below 12,000 feet. The pileolated warbler (*Wilsonia pusilla pileolata*) and the white-crowned sparrow (*Zonotrichia leucophrys*) breed regularly in the thickets of alpine willows for 500 feet above timberline, but their breeding range also extends down through the Hudsonian zone. Other birds observed as stragglers above timberline are *Buteo borealis calurus*, *Chordeiles virginianus henryi*, *Corvus corax sinuatus*, *Junco phæonotus caniceps*, and a humming bird (probably *Selasphorus platycercus*).

PLANTS OF COLORADO ARCTIC-ALPINE ZONE.

The only shrubs able to withstand the rigorous climate on the wind-swept slopes of this region are several species of alpine willows, among which are *Salix petrophila*, *S. chlorophylla*, and *S. glaucops*, with its smooth variety *glabrata*. Dense thickets of these willows from a few inches to 3 feet in height occur from timberline to 13,000 feet, chiefly in ascending tongues through alpine bogs on the slopes of gulches and basins (see fig. 35); while *S. petrophila*, at least, is met with sparingly on the highest summits, at 14,000 feet. Some of the plants characteristic of the region above timberline are *Silene acaulis*, *Saxifraga debilis*, *Leptasea austromontana*, *Micranthes rhomboidea*, *Rhodiola polygama*, *Clementsia rhodantha*, *Mertensia alpina*, *Myosotis alpestris*, *Pedicularis grœnlandica*, *Polemonium confertum*, *Polygonum viviparum*, *Swertia palustris*, *Sieversia turbinata*, *Phlox condensata*, *Besseya alpina*, *Trifolium nanum*, *Thlaspi purpurascens*, and *Macronema discoideum*.[1] Most of the vegetation present above 13,000 feet consists of mosses and lichens.

MAMMALS OF COLORADO.

The following list is believed to include all species of mammals known to occur in Colorado, and aims to furnish accurate knowledge of their geographical and vertical distribution within the State. As already stated, it is based primarily upon investigations conducted in Colorado by the writer during the field seasons of 1905, 1906, 1907, and 1909. In addition, the data secured by other members of the Biological Survey during the past 20 years have been incorporated, and all important articles bearing on the subject, both old and recent, have been freely quoted.

The first accurate information regarding Colorado mammals was obtained on Maj. Long's expedition in 1820. Several species new to science were obtained within the State, and were described by Thomas Say in the Report of Long's Expedition to the Rocky Mountains, v. 2, 1823.

In the summer of 1871 Dr. J. A. Allen spent four weeks in Park County, securing data which later formed the basis of an important paper on the mammals of the South Park region, published in the Bulletin of the Essex Institute, VI, pp. 53–58, 1874.

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[1] As indicative of the arctic environment of this region, note the occurrence of *Pedicularis grœnlandica*, *Myosotis alpestris*, and *Polygonum viviparum*—species which are abundant in Greenland and Alaska.

Many Colorado mammals collected in the course of the United States Geographical Surveys West of the One Hundredth Meridian are recorded by Coues and Yarrow in v. 5 (Zoology) of the Report of the Survey, 1875. Other articles and notes of less scope pertaining to the subject, which have appeared from time to time in various publications, need not be detailed. Four important recent publications on Colorado mammals, however, often quoted in the present report, are here cited in full to avoid frequent repetition of the complete reference.

Allen, J. A. List of Mammals Collected by Mr. Charles P. Rowley in the San Juan Region of Colorado, New Mexico, and Utah, with Descriptions of New Species. <Bull. Am. Mus. Nat. Hist., V, pp. 69–84, 1893.

Warren, Edward R. The Mammals of Colorado. <Colorado College Publications, gen. ser. no. 19, Science ser. no. 46, XI, pp. 225–274, 1906.

Warren, Edward R. Further Notes on the Mammals of Colorado. <Colorado College Publications, gen. ser. 33, Engineering ser. 1, No. 4, pp. 59–90, 1908.

Warren, Edward R. The Mammals of Colorado. Pp. 300, with maps and numerous text figures. New York and London, 1910.

Didelphis virginiana Kerr. Virginia Opossum.

An apparently authentic instance of the occurrence of the opossum in Colorado was given me by Mr. George Heckler, a ranchman living in Shell Rock Canyon, in the northwest corner of Baca County. Mr. D. A. Rhinehart, of Lamar, who was familiar with the opossum farther east, afterwards verified Mr. Heckler's statement.

Mr. Heckler states that during the winter of 1903–4 he was hauling supplies from Las Animas to the sheep camps in southern Bent and Las Animas Counties, and one stormy evening camped in an old cabin among the cottonwoods near the head of Caddoa Creek, some 12 miles north of Gaume's ranch. Soon after kindling a fire in the fireplace, he saw a peculiar animal skulk in at the open door, and knocked it over with a stick of wood. After examining it and noting that it was an animal with which he was unacquainted, Mr. Heckler left it lying near the door, apparently dead. Happening to glance in its direction a little later, however, he saw the eyes slyly open for a look around, and the tales of "playing 'possum" which he had read came to his mind. Mr. Heckler kept the animal alive and gave it to a gentleman residing a few miles north of Springfield, where Mr. Rhinehart saw it soon after its capture.

The opossum is known to occur commonly in west-central Kansas, in western Oklahoma, and along certain of the streams on the Texas Panhandle. The individual captured on Caddoa Creek was probably a straggler, as careful inquiry in the Arkansas Valley and elsewhere in the region elicited no information respecting the presence of opossums. It may have reached the head of Caddoa Creek either by way of the

Arkansas, which is heavily fringed with cottonwoods from middle Kansas westward, or from the southeast, through the valley of the Cimarron River. Either route is a logical one for *Didelphis* to follow westward. Caddoa Creek is a southern affluent of the Arkansas River and has a scattering fringe of cottonwoods along most of its length. The region at the head of Caddoa Creek is wild and unsettled, and the cabin where the opossum was captured is the only one in many miles.

Cervus canadensis Erxleben. Elk; Wapiti.

The elk is now exterminated over much of its former range in Colorado, and the few bands which remain in the wildest parts of the western plateaus and mountains are small and widely scattered. The huge piles of antlers at many of the ranches in the northern mountains are a mute testimony to the former abundance of this noble animal. Estimates in 1898 placed the number of elk in Colorado at 7,000; in 1902 at 3,000. In 1909 their numbers were reduced to considerably less, and were divided about equally between northern and southern Colorado.[1] Conservative estimates of the number in Routt and Rio Blanco Counties varied from 200 or 300 to twice that number. Mr. Andrew R. Hodges, a well-known game warden with wide experience in the elk range, thinks there were fully 400 and possibly 500 elk in the mountains of Gunnison County up to 1909. In addition there are known to be small bands in the San Juan and La Plata Mountains and elsewhere.

In 1905, when I began work in Colorado, a few elk were still found in the Rabbit Ear Mountains, ranging on both their north and south slopes near the heads of Troublesome Creek (Middle Park) and Arapahoe Creek (North Park). A small band was said to range the Vasquez Mountains, and also on the headwaters of the Williams Fork of Grand River, while several other bands were reported on the White River Plateau, southeast of Meeker, probably at one time the best elk range in the State. In August, 1905, I found the nearly complete skeleton of a large bull elk in a narrow box canyon along the East Fork of Rifle Creek, 20 miles northeast of Rifle, and saw many mounted heads in Meeker, Newcastle, and Glenwood Springs. Mr. A. G. Wallahan, of Lay, reported that, unless they had been killed since 1904, a fair number of elk still remained in the Flat Top country at the eastern end of the Williams River Mountains.

In 1906 I learned of a few elk in the Danforth Hills (northwest of Meeker), in the mountains west of Green River, and along the crest of the Book Cliffs. A small band reported on the head of Elk River, on the western slope of the Park Range, is said to cross occasionally to the neighboring Elk Head Mountains. A mounted head at Baggs Crossing, Wyoming, belonged to a large bull elk which a trapper named Criss shot in the region between Sunny Peak and the Vermillion Bluffs in 1902. During the winter of 1905–6 two elk were seen at the Sand Springs, west of Sunny Peak, Routt County. Apparently none remain on the Medicine Bow and Front Ranges, or on the divide east of Laramie River, since I could get no definite information regarding their presence in that region in 1906. Dr. A. K. Fisher learned of a few on the south side of Longs Peak in 1894.

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[1] Careful estimates made by the Forest Service officers in the spring of 1911 show a total of about 2,100.

In 1907, 12 or 15 elk were reported in the Cochetopa Hills west of Saguache, and forest rangers estimated that there were nearly 100 remaining on the San Juan Mountains. These are much scattered, and are usually encountered singly or in twos or threes. One of the largest bands, consisting of about a dozen individuals, is said to range near the summit of the San Juans south of Wagon Wheel Gap. The same year fully 50 elk were reported in the La Plata Mountains, their favorite range being on the head of Hermosa Creek, northwest of Durango. Warren states that a few elk remain in Delta and Pitkin Counties.[1] They must have been at one time very abundant in the West Elk Mountains, as at Cebolla, in 1907, I saw large piles of antlers in front of the hotel.

Allen says that elk were becoming rare in Park County in 1871;[2] and Brewer, writing of South Park at the same period, records but three individuals observed by his party.[3] Trippe has recorded elk from the higher parts of Clear Creek County.[4]

Forest Supervisor H. N. Wheeler thinks the region on the head of Hermosa Creek, in the Montezuma National Forest, would be an ideal location for a national game preserve, with special reference to elk, since so many are living in that region. State and national pride should demand that this noble game animal, which formerly ranged the Colorado mountains by thousands, be given the protection which only a game preserve can afford. The close season on elk in Colorado extends to November 1, 1924 (amendment of 1909). It has hitherto been very difficult, however, to obtain in the wildest mountain districts a strict enforcement of the game laws.

Mr. Barrett Littlefield, of Slater, Routt County, had about 100 elk in captivity on his ranch on the northern slope of the Elk Head Mountains, a short distance south of that point, in 1906, and had raised calves and steer elk for a number of years, readily selling the dressed meat for 20 cents a pound at the nearest railroad point, Rawlins, Wyoming. The steer elk are said to weigh from 500 to 600 pounds when well grown. Gray wolves have killed a number of elk from Mr. Littlefield's herd during the past few years.

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[1] Mammals of Colorado, Colo. College Pub., Sci. ser. no. 46, XI, p. 236, 1906.

[2] Bull. Essex Inst., VI, p. 56, 1874.

[3] Am. Nat., V, p. 220, 1871.

[4] See Coues, Birds of the Northwest, p. 224, 1874.

Odocoileus virginianus macrourus (Rafinesque). White-tailed Deer.

The white-tailed deer is at present uncommon, being largely restricted to the foothills and eastern slopes of the front ranges, where it occurs sparingly across the entire width of the State. A very few have been killed on the mountain slopes bordering the San Luis Valley, but it appears to be absent from other sections west of the main ranges. In early days this deer was found pretty generally over the plains region of eastern Colorado, where it frequented the thickets and cottonwood growth which fringed the Platte, Cache la Poudre, Boulder, Arkansas, and other streams.

In 1905 Mr. Walter Blanchard informed me of a pair of white-tailed deer which had been on his ranch 5 miles west of Boulder for a number of years, and he has several times seen fawns. I saw deer tracks in the gulches in that vicinity several times during June, 1905. Near the summit of Floyd Hill, in the eastern edge of Clear Creek County, a fine large buck jumped from a dense thicket of dwarfed aspens directly in front of me, June 23, 1905. Settlers in that vicinity report small numbers of deer in the heavy forests several miles south of Clear Creek. A few white-tailed deer were reported in the yellow-pine belt west of Arkins, Larimer County, and in the Laramie River region. Mr. T. J. McKenna, of the Stevens mill, on Mount McClellan, states that this deer formerly occurred in the Grays Peak region, but that none have been seen recently. A specimen from the Cache la Poudre River was in the collection of mammals which Mrs. M. A. Maxwell exhibited at the International Exposition at Philadelphia in 1876.

White-tailed deer were reported at a number of localities in southern Colorado in 1907. A few are said to have been killed in the Wet Mountains east of Westcliffe during recent years. Mr. J. W. Frey, of Salida, considers the species of rare occurrence in that vicinity, but states that a few have been seen recently in Pleasant Valley, on the east side of the Sangre de Cristo Range. This deer is reported rare at both La Veta and Bradford, in western Huerfano County, but several have been killed on the San Luis Valley slope of the Sangre de Cristo Range, in the vicinity of the Mosca and Medano Passes, within the past 10 years, according to the cowboys of the Medano Springs ranch. There is a skull in the National Museum from Rio Grande County, on the western side of the San Luis Valley.

Most of the hunters with whom I conversed had never seen the white-tailed deer in the juniper country of Las Animas and Baca Counties, but Mr. D. A. Rhinehart, of Lamar, stated that a very few were killed there in early times. The species was formerly common among the cottonwoods and willows along the Arkansas River, but apparently none remain. A ranchman living at Prowers Station, west of Lamar, is said to have a few in captivity, but I was unable to learn where they were secured. Warren gives the following data:

"C. E. Aiken says there are a few in the foothills west of Monument, El Paso County, unless recently killed off. Dr. W. H. Bergtold tells me it is still found near Trinidad and southward, and also in parts of the Arkansas Valley, between Pueblo and the State line."[1] Trippe says "*Cervus leucurus*" was formerly common in Clear Creek County.[2]

Odocoileus hemionus (Rafinesque). Mule Deer.

The mule deer has a much more general distribution in Colorado than *O. macrourus*, and ranges from the lowest foothills occasionally to timberline. It is found in every county west of the Continental Divide, being probably most abundant in Routt and Rio Blanco Counties. East of the main ranges a few are left in the rough juniper country of Las Animas and Baca Counties, in the higher parts of El Paso, Teller, and Jefferson Counties, and in 1907 they were reported tolerably common in the foothills of Custer and Huerfano Counties. Mr. Edward A. Preble reported a few mule deer in the Estes Park region in 1895, but I heard of none in the foothills of Boulder and Larimer Counties in 1906. Apparently none remain on the plains east of the mountains, where they were common in early times.

Abundant signs of deer were noted on all the mountains and plateaus west of the Front and Medicine Bow Ranges in August and September, 1905 and 1906. The aspen forests on the Rabbit Ear Mountains, White River Plateau, and in the Hahns Peak country were especially frequented by them, and large piles of antlers were seen at ranches throughout the region. The Flat Top country of the Williams River Mountains, west of Egeria Park, was said in 1906 to be the best deer country in the State. All the many hunting parties which I met returning from this region or the White River Plateau early in October of that year had been successful.

Mr. A. G. Wallahan, of Lay, Routt County, states that prior to 1900 large herds aggregating many hundreds of mule deer passed his ranch on the Lay game trail each fall in regular migration from their summer home in the Elk Head and Williams River Mountains to the winter range in the rough juniper and pinyon country bordering the lower Snake and Bear Rivers. Since 1900 their numbers have been greatly depleted, and during the winter of 1904–5 Mr. Wallahan saw only 17 in the vicinity of his ranch. These semiannual migrations performed by the mule deer from high to low country in the fall, and back again to the mountains in the spring, are now scarcely perceptible in most sections where 5 or 10 years ago they were important events.

In 1907 this deer was reported as tolerably common in the San Juan and La Plata Mountains, in Archuleta, La Plata, and Montezuma Counties. Formerly there was a regular movement down into the pinyon country on the Indian reservation along the southern border of the State, but during the past few years the Ute, Navajo, and Apache Indians have been ruthlessly slaughtering deer, and the greater number now remain throughout the year in the high country, where they are comparatively safe. Forest Ranger E. E. Chapson states that at present coyotes are the worst enemies of deer in the San Juan Mountains north of Pagosa Springs, as they kill a great many fawns in summer and numbers of adults in winter, when the snow crust impedes the deer's progress, but is strong enough to bear the weight of the coyotes. Mr. Chapson has often found the carcasses of deer thus killed, and states that the coyotes, usually hunting in bands of five or six, first hamstring the deer, after which they easily kill it. Mountain lions also kill a large number in the San Juan and La Plata Mountains.

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[1] Mammals of Colorado, p. 237, 1906.

[2] See Coues, Birds of the Northwest, p. 224, 1874.

During the same season (1907) deer were reported common at various other points. On the Uncompahgre Plateau tracks were seen in abundance, both in the sandy yellow pine country at the head of Dominguez Creek and in the trails leading through the aspen groves along the crest of the plateau near Uncompahgre Butte. In the Coventry region a good many deer were inhabiting the pinyon country during July, and tracks were common also in the aspen country on Lone Cone. Before sunrise July 24 I saw a doe browsing in the willow brush in the bottom of the Naturita Canyon, near Coventry. Mule deer were quite common late in June in the oak and aspen thickets of the Lone Mesa region, where they were feeding extensively on acorns. During the winter they are said to range chiefly in the yellow pine country on the Dolores Plateau. Just before sunset June 26, as I was crossing a ridge on the southwest flank of Beaver Mountain, southeast of Lone Mesa, my eye was arrested by a beautiful sight. Standing in a small grassy opening among the dense oak chaparral a hundred feet below me and in the shade of the ridge, with head thrown back over his shoulders, nose pointing exactly in my direction, and every sense alert, stood a large, sleek-coated, 4-point buck. I stopped in plain sight and silently watched the old fellow for fully five minutes, and he apparently regarded me with equal interest. His curiosity was fully satisfied, however, the moment I quietly and slowly concealed myself among the oak brush, and lowering his head he loped off through the chaparral.

Deer were reported as more abundant than usual on the mountains bordering the San Luis and upper Arkansas Valleys, and nearly all the hunters outfitting at Buena Vista, Salida, and Saguache during the open season of 1907 met with success. A locomotive on the Denver & Rio Grande Railroad, running light, killed a fine buck November 8, in Browns Canyon, 6 or 8 miles north of Salida. On the western slopes of the Sangre de Cristo Range the mule deer is said to be usually found in the pinyon belt between 8,000 and 9,000 feet, although occasionally met with at timberline in summer and early fall. I was informed that deer were scarce in 1907 on the head of Smiths Fork, in the West Elk Mountains, and this was the case also in western Montezuma County.

Allen found mule deer, "*Cervus macrotis*," common near timberline in Park County in 1871;[1] while Trippe recorded the species as formerly common in Clear Creek County.[2]

The Colorado game law in force during 1907 and 1908 allowed the killing of one deer "with or without horns" by any person during the open season. This inclusion of deer without horns worked incalculable injury to the deer of Colorado during the two years it was operative, as a great many does and fawns were killed by unscrupulous hunters and particularly by novices. The pernicious results were not fully manifest in 1908, when it was estimated a total of about 2,500 deer were killed during the open season, but reports show that a great scarcity of deer throughout the mountains marked the season of 1909.

Antilocapra americana (Ord). Antelope.

Antelope are now comparatively scarce even in the thinly settled parts of the eastern plains region, and few remain on the sage plains of North Park and Routt County, where formerly there were thousands. A small number are still present in San Luis Valley. Most of the antelope of eastern Colorado are now in three areas—on the plains of western Baca and southern Otero, Bent, and Prowers Counties; on the Arkansas Divide; and in northwestern Logan and northeastern Weld Counties.

That this most graceful game mammal is doomed to early extinction in many sections seems probable despite the protection afforded by law, but the increase in numbers during the past few years, both on the Arkansas Divide and in northeastern Weld County, is very perceptible. The decrease of antelope in the State at large during the past 10 years, however, has been very great. In 1898 the State game warden placed the number at 25,000, while in 1908 the game commissioner estimated not over 2,000. A conservative estimate based on data collected by the Biological Survey would be not over 1,200 in 1909. Many cowboys and even ranchmen in the outlying districts kill antelope whenever they can. It is gratifying, however, to find that many large ranch owners have the public interests and the preservation of game sufficiently at heart to afford this fine mammal rigid protection on the ranges under their control.

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[1] Bull. Essex Inst., VI, p. 56, 1874.

[2] See Coues, Birds of the Northwest, p. 224, 1874.

Mr. A. G. Wallahan, of Lay, the well-known photographer of big game, estimated in 1905 that 300 would fully cover the number of antelope remaining in Routt County. He reported a band of about 30 on the Iron Springs Divide, east of Godiva Ridge, and another larger band near Junction Mountain, between the Snake and Bear Rivers. In 1906 I was informed by Mr. John Criss, of Baggs Crossing, Wyoming, a trapper of many years' experience in Routt County, that only a few hundred antelope are left in that region; whereas as recently as 1898, immense herds, aggregating thousands of individuals, wintered there. During the summer the antelope were scattered over the sage plains in small bands. Mr. Criss thinks that persistent hunting in that region drove most of the antelope northward to the Wyoming plains. In 1906 antelope were reported in small numbers in North Park; on the sage flats bordering Muddy Creek, in northwestern Middle Park; on the divide between the Snake and Green Rivers, north of the Escalante Hills; and in the parks on the O-wi-yu-kuts Plateau. In August, 1906, I saw the tracks of small bands at the eastern end of Godiva Ridge (Routt County) and near Higho (North Park), while five or six were watering at Elk Springs, 8 miles south of Lily. I saw none in Mesa County, and Warren states, on the authority of Mr. W. P. Ela, of Grand Junction, that but two or three have been killed in that region during the past 20 years.[1]

Numerous data on the distribution of antelope in the San Luis Valley and in other parts of southern Colorado were gathered during the summer of 1907. None appear to remain in Montezuma County, and hunters in that region state that few were ever found there. Mr. George J. Ashbaugh, living in the McElmo Canyon, told me that the last antelope seen by him were three or four on the watershed between Yellow Jacket and McElmo Creeks about 1897. A conservative estimate of the number of antelope in the San Luis Valley would be from 50 to 75. The cowboys of the Medano Springs ranch, who range the eastern side of the valley from Crestone south to Garland, state that there are about 30 or 40 in that region, the largest band, consisting of about 25, being found on the Luis Maria Baca grant, south of Crestone. Others are scattered over the plains from the west base of Sierra Blanca north to the northern end of the sand dunes, west of the Medano Pass. Antelope are reported between Garland and San Luis, at the west base of the Culebra Range, and Vernon Bailey heard of a few in the unsettled region between Antonito and the Rio Grande in 1904. Mr. C. H. Auld, of Colorado Springs, reports seeing an antelope from the train between La Jara and Antonito September 18, 1907.

An antelope is said to have been killed, in the fall of 1907, within sight of Salida, presumably on the extensive flats in the Arkansas

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[1] Mammals of Colorado, p. 237, 1906.

Valley northwest of that point. This appears to be the only recent record in the upper Arkansas Valley. Antelope were not uncommon in South Park in 1871, according to Allen.[1] They were formerly abundant in the Wet Mountain Valley, but none have been seen in that region for several years.

Conservative estimates made by residents of Baca County in the fall of 1907 placed the number of antelope in that region at between 50 and 100. The majority were said to range on the level short-grass plains of western Baca County, just east of the rough juniper country. Very few are reported in eastern Baca County, which is well settled. Prof. D. E. Lantz reports possibly 12 antelope on the plains north of Higbee, in southeastern Otero County, in 1910.

Antelope were reported by Mr. C. P. Streator as common on the high plains of the Arkansas Divide near Flagler and Limon in 1894, and Prof. Lantz says their numbers were increasing near Hugo in 1905, owing to rigid protection. In May, 1909, I saw a band of fully 20 from a Rock Island train about 10 miles east of Limon, and in crossing the Arkansas watershed from Cheyenne Wells northwest to Seibert I saw several small bands. One band of nearly 200 is said to have been seen near Agate, on the northern slope of the Arkansas Divide, northwest of Limon, in December, 1908. Several antelope were run over by trains in that vicinity the same winter, which was one of excessive snowfall. This was due to the fact that, in feeding along the railroad right of way, which was kept fairly clear of snow, the antelope became quite unsuspicious and accustomed to passing trains.

In driving from Sterling northwest to Grover early in June, 1909, several small bands of antelope were encountered on the flats bordering Horsetail Creek south of the Chimney Cliffs, while on the undulating grassy plateau northwest of Pawnee Buttes, where the antelope seemed most numerous, 19 were counted in the course of a short morning's drive. From observations made during the winter of 1908–9 residents variously estimate at from 200 to 300 the antelope in the region between the Burlington Railroad from Cheyenne to Sterling and the Nebraska boundary. A point 10 miles west of the Platte River at Iliff indicates the present eastern limit of range in winter, while the summer range is still more restricted.

A very few antelope are found in Yuma County, according to Mr. W. E. Wolfe, of Wray. Mr. H. G. Smith, of Denver, states that they were last seen in Denver County in the late seventies.

Bison bison (Linn.). Buffalo; American Bison.

The buffalo was formerly present over much of the State, even ranging in summer to timberline in certain sections of the mountains, as is proved by the bleached and weathered skulls occasionally found at that elevation. While most numerous on the plains east of the mountains, they nevertheless must have been common in the larger mountain parks, especially on the sage plains of North Park, where the bleached skulls, now rapidly disintegrating after more than 20 years' exposure, may still be seen in considerable numbers. A favorite range of the buffalo was the extensive region of sage plains in western Routt County, where in sections least frequented by range cattle the deeply worn trails can still be distinguished. Few, if any, well-preserved skulls can be found at the present time. On my trips in North Park and in Routt County in 1905 and 1906 I met with only one skull at all complete, and in this case the teeth were lacking. This skull was found embedded in a bog north of Higho, North Park, and had been little exposed to the weather. In most of the skulls found the nasals and horn sheaths, as well as the teeth, are missing.

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[1] Bull. Essex Inst., VI, p. 56, 1874.

The South Park plains were much frequented by buffalo in early times, and nearly all the travelers passing through the region mentioned them. They were by no means confined to the open grassy plains of the park, since Brewer records skulls found on the bordering mountain slopes as high as 11,000 feet in both openings and forests.[1] The same writer states that the mountain animals were unlike the buffalo of the eastern plains, being smaller, with longer, shaggier, and blacker hair.[2] Allen mentions bleached skulls found far above timberline on Mount Lincoln, by Mr. Bennett and others on the "extremest sources" of the Platte River.[3] Warren records a skull which he found in the mountains near Irwin, Gunnison County, at nearly 11,000 feet, and states that he has seen skulls at other localities in the West Elk Mountains.[4]

The data at hand respecting the time of the buffalo's disappearance in most sections of the mountains are scanty. According to Brewer (l. c.) it was abundant in South Park previous to 1862, and a few were shot in 1867, while he "heard of none in 1869." Allen (l. c.) states that a small band was seen along the Platte River in South Park in June, 1871, while Coues and Yarrow, writing of the South Park region, state that a few were seen and two were killed in 1873.[5] Mounted specimens in the Maxwell collection of Colorado mammals exhibited at the Philadelphia Exposition in 1876 were shot in September, 1873, near Mount Whiteley, Middle Park, according to Coues, who also states that a small band of buffalo still lingered in North Park in 1876.[6] The last buffalo in the Pikes Peak region seems to have been a bull, killed in 1879 near the Seven Lakes, and mounted by Mr. C. E. Aiken, of Colorado Springs, as recorded by Warren (l. c.). The famous and somewhat mythical "Lost Park Herd" appears on good authority to have lived in the fastness of its mountain retreat in comparative safety for many years after its fellows in other sections of the mountains had been exterminated. The remnant of this herd—two bulls, one cow, and one calf—were all killed in February, 1897, in Lost Park, near Bison Peak, Park County.[1] The last buffalo in Routt County appears to have been one killed by Ute Indians at Cedar Springs, 6 miles west of Craig, in 1884.[2]

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[1] Am. Nat., V, p. 221, 1871.

[2] In this connection, see Allen, Bull. Essex Inst., VI, p. 55, 1874.

[3] Bull. Essex Inst., VI, p. 55, 1874.

[4] Mammals of Colorado, p. 239, 1906.

[5] Explorations W. of 100th Meridian, V, p. 67, 1875.

[6] Dartt, On the Plains and among the Peaks, p. 221, 1879.

The buffalo of the plains east of the mountains appear to have made their last stand in Baca County, in the extreme southeast, where one was killed near Springfield as late as 1889. This is the same year that the remnant of the Texas herd, driven to the northwest corner of the Panhandle, was estimated by Dr. W. T. Hornaday at 25.[3] As the Baca County plains are practically a northern continuation of the Llano Estacado, and but a short distance north of the Panhandle, it seems altogether likely that the buffalo killed in Baca County, a cow heavy with calf, had strayed from the Texas herd, as the animals remaining on the eastern Colorado plains had been exterminated several years before.

Ovis canadensis Shaw. Mountain Sheep; Bighorn.

A few bands of mountain sheep live on nearly all the high mountain ranges of Colorado. On the main ranges they are usually seen at or near timberline and seldom below the Canadian zone. On the plateaus and in the rough country of western and southwestern Colorado, however, they occur at much lower elevations.

Mountain sheep show a gratifying increase during the past few years over the State at large. Although they have been protected by law in Colorado since 1885, the marked increase at the present time is the result both of a more efficient game-warden service and of local protection afforded by an aroused public sentiment. A danger which threatens mountain sheep in Colorado, as well as in other Western States, is the introduction of scab from domestic sheep allowed to graze on the higher mountain slopes. An instance is given by Warren, as follows:

> C. F. Frey tells me they suffer much from scab in the West Elk Mountains, and that a party told him in 1902, at one place near the head of Sapinero Creek, 75 head were counted which had died of scab. Domestic sheep have been run in that locality, and the wild sheep doubtless contracted it from them.[4]

In the northern ranges mountain sheep were tolerably common in 1905 and 1906. Lumbermen at Fraser, Middle Park, reported two bands, each numbering about 20, in the neighboring mountains. One of these bands is found on the Front Range, west of Berthoud Pass, and thence north on the Vasquez Mountains to Vasquez Peak; the other is usually seen near Arapahoe Peak, but ranges along the crest of the Front Range from James Peak as far north as Longs Peak. The sheep reported in the vicinity of Silver Plume and Graymont doubtless belong to one of these bands. Another large band was said to be found on the Medicine Bow Range between Lulu Pass and Clarks Peak. At Spicer, North Park, I saw the heads and capes of two fine rams which had been killed near Clarks Peak in the spring of 1905. These heads measured between the horn tips 15 and 15½ inches, respectively. This band is stated to range near timberline even in winter. A few sheep are still found in the mountains near Estes Park, but they are more common on the western slope of the range. A band of about 30 was seen by Nelson in the summer of 1883 on the summit of the range west of Estes Park. They were reported in 1905 as tolerably common on the Park Range between Buffalo Pass and Mount Zirkel. Other small bands were reported in the Elk Head Mountains and near Pyramid Peak in the Williams River Mountains. Mr. John Criss, of Baggs Crossing, Wyoming, states that one or two sheep have been killed in the rough country north of Snake River, in the vicinity of Sunny Peak, since 1900. A very few were also reported on Junction Mountain (between Snake and Bear Rivers), and on Zenobia Peak and Mount Cullom, near the Ladore Canyon of Green River. In 1902 Dall De Weese estimated their number as probably 700 in the State. A large ram was killed among the Snake River bluffs north of Lily during the winter of 1905–6.

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[1] See American Field, p. 273, Mar. 19, 1910.

[2] Felger, Univ. of Colo. Studies, VII, No. 2, p. 143, 1910.

[3] Extermination of the American Bison, Rept. U. S. Nat. Mus., 1889.

[4] Mammals of Colorado, p. 238. 1906.

On October 16, 1906, while far above timberline in the mountains south of James Peak, and on the edge of a small lake in a deep basin surrounded by rather precipitous walls, the crashing of a number of loosened rocks on the slope opposite broke the deep silence. No sheep were visible on the rocky ledges far above, but upon climbing the steep slope I discovered the fresh tracks of a large ram and a ewe in the snow on the crest of the divide at 13,000 feet.

In 1907 sheep were reported on most of the mountain ranges of southern Colorado, and seemed to be on the increase. The sharp, jagged peaks and ridges of the high and narrow Sangre de Cristo Range afford a fine home for them, and they are said to be found along its entire length, being in greatest numbers in the Sierra Blanca group at the southern end. Cowboys riding for the Medano Springs ranch often meet with sheep among the pinyons along the lower western slopes of the Sangre de Cristos between Mosca Pass and the southwest flank of Sierra Blanca. A very few are reported also on West Spanish Peak, south of La Veta, and on Pikes Peak. Forest

Ranger E. E. Chapson, of Pagosa Springs, says that a good many sheep are killed by snowslides in the San Juan Mountains north of that point. In one instance he discovered the carcasses of three or four sheep which apparently had been so closely shut in by a snowslide as to be at the mercy of a band of coyotes. The snow crust was sufficiently strong to bear the light-footed coyotes, but too weak to support the heavy-bodied sheep, and unmistakable signs in the snow showed that the sheep had been killed and partly eaten. Mr. J. P. Galloway, of Norwood, states that sheep are often seen on Dolores Mountain, but seldom range west across the valley to Lone Cone, the westernmost peak of the San Miguel Mountains. Some years ago a band of about 20 crossed to the Cone, but soon returned to the more extensive range on Dolores and neighboring mountains.

Mountain sheep are not at all uncommon in the rough Upper Sonoran country of extreme western Montrose and Mesa Counties. Most of the region on both sides of the Dolores River below Paradox Valley is very precipitous and quite inaccessible, affording an excellent sheep range. Most of the sheep in this region live on the east side of the Dolores, between Salt Canyon and the mouth of West Creek, chiefly on the very broken southwest face of the Uncompahgre Plateau. A very few are reported among the rocky ridges just below the steep northern rim of West Paradox Valley, and Mr. William Boren, of Norwood, informed me of a lone ram which has been seen several times on the rocky points along the east side of the Dolores Canyon, just south of Paradox Valley. Sheep are said to be tolerably common in the West Elk Mountains, and occasionally range down to the cliffs along the Gunnison, southwest of Crawford, during the winter.

Brewer found sheep common on the mountains surrounding South Park in 1871, and states that they were particularly abundant above timberline on the highest peaks.[1]

[**Sciurus niger rufiventer** Geoffroy. Western Fox Squirrel.

Fox squirrels are not indigenous to Colorado, but have been introduced at Greeley, where they are increasing in a gratifying manner, and also, according to Young, at Denver.[2]]

Sciurus aberti ferreus True. Northern Tuft-eared Squirrel.

Sciurus aberti concolor True, Proc. U. S. Nat. Mus., XVII, p. 241, 1894. Type from foothills west of Loveland, Larimer County, Colorado. (Not of Blyth.)

Sciurus aberti ferreus True, Proc. Biol. Soc. Wash., XIII, p. 183, 1900.

This interesting form of *Sciurus aberti* has a much interrupted range in the yellow pine belt of the eastern foothills, between 6,000 and 8,000 feet in northern Colorado, and chiefly between 7,000 and 9,500 feet farther south. Judging from the meager data at hand its range was formerly continuous or nearly so, but now it is largely restricted to the higher foothills west of Loveland, eastern Park and southern Jefferson Counties, the Arkansas Divide between Monument and Eastonville, and the eastern slopes of the Sangre de Cristo Range between the Medano and Mosca Passes. (See fig. 2.)

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[1] Am. Nat., V, pp. 220-221, 1871.

[2] Proc. Acad. Nat. Sci. Phila., p. 406, 1908.

Although the species is commonly reported by hunters and ranchmen in the foothills of southern Larimer County, my experience in the pine belt west of Arkins (practically the type locality) in July, 1906, leads me to believe that it is now uncommon, if not rare, in that section. Several days were spent among the heavy forests of yellow pines between 6,000 and 7,500 feet in a systematic search for these squirrels, but not a single one was seen or heard. One informant stated that the squirrels come down into the valleys in the autumn and feed extensively upon the wild plums. In October, 1894, Mr. C. P. Streator collected two squirrels 12 miles west of Loveland, but found the animals scarce. He attributed this scarcity to a shortage in the crop of pine cones, upon which the squirrels are said to feed. In the fall and winter months of 1894, 1895, and 1896 Mr. R. S. Weldon collected 12 specimens 3 miles northwest of Arkins and 1 at Bellevue. Possibly this squirrel lives at a higher elevation in summer than in winter, but there are no data on this point. The type

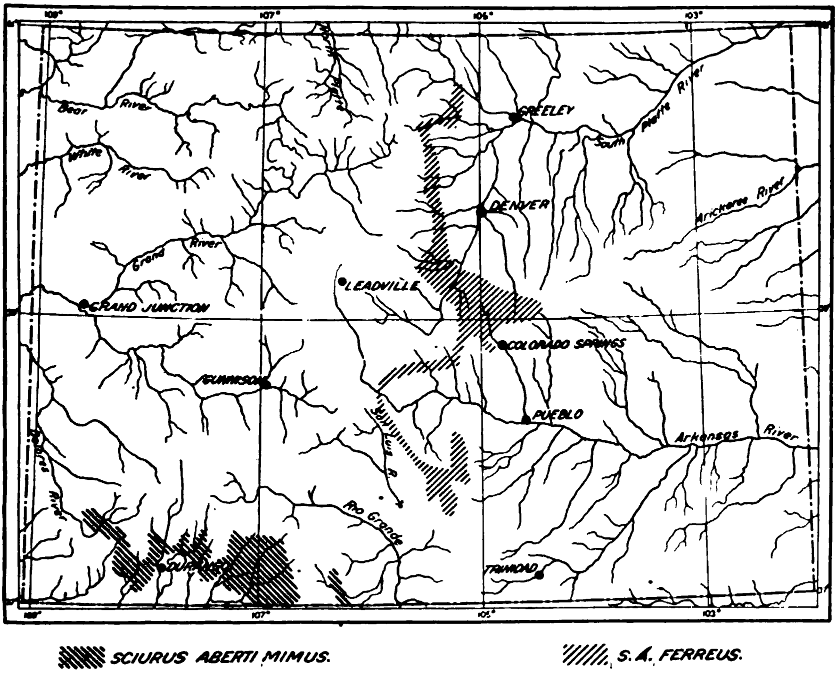

FIG. 2.—Distribution in Colorado of tuft-eared squirrels (*Sciurus aberti mimus* and *S. a. ferreus*).

and one topotype in the National Museum were collected west of Loveland by Mr. W. G. Smith.

In 1905 Mr. Edward Allensby, living in the South Boulder Canyon, 14 miles southwest of Boulder, reported a few of these squirrels in the pine forests of that vicinity, stating that they were usually observed during the winter months. Mr. Walter Blanchard, of Boulder, saw a melanistic specimen which was killed near Sugar Loaf Mountain, 10 miles west of Boulder, about 1903. Mr. T. J. McKenna, of Denver, states that many years ago, while located at Jamestown, Boulder County, a few black squirrels were found in that vicinity. In 1894 Streator learned of five squirrels which had been killed in the vicinity of Gold Hill.

This squirrel was reported at a number of localities in southern Colorado in 1907, where it seems to be more common than farther north. It was said to be not at all uncommon in the pine forests of eastern Park County between 8,000 and 8,500 feet, especially on Craigs Creek and along the North Fork of the Platte near Bailey. Prof. D. E. Lantz found it common among the pines at Cascade in July, 1910. Mr. J. W. Frey reports a very few in the Arkansas Hills east of Salida, and Mr. C. E. Aiken, of Colorado Springs, has a summer skin from the Cripple Creek region, which is gray with a trace of reddish in the middle of dorsum, thus greatly resembling *S. a. mimus* in faded pelage. *Sciurus ferreus* has been seen on the San Luis Valley side of the Sangre de Cristo Range, according to cowboys of the Medano Springs ranch, Mr. William King having seen a few gray individuals among the pines at the west end of Mosca Pass, and others reporting it from Medano Pass. The species is quite generally distributed along the eastern slopes of the Sangre de Cristos north at least to Westcliffe, and it is said to occur also in the Wet Mountains. In the region around Bradford, in the northwestern corner of Huerfano County, this squirrel is said to be tolerably common, both on the slopes east of Medano Pass and in the pine-clad gulches of Promontory Bluffs, the vertical range here being from 8,000 to 9,500 feet. The inclement weather prevailing in this region during mid-November doubtless accounted for the inactivity of squirrels, as none were seen, but signs of their presence were found in large nests of pine needles in the upper branches of pines and also in fresh cuttings scattered here and there over the forest floor.

The species reaches its greatest abundance in the yellow pine forest on the Arkansas Divide between Eastonville and Monument. In the forest southwest of Eastonville the squirrels were active during the bright crisp days of early December. The forest floor for a considerable radius around the nest trees was generously sprinkled with fresh green cuttings of branch tips, pieces of gnawed bark, and freshly peeled twigs, while a few of the upper limbs of the trees were gnawed and peeled in places, much as if by porcupines. The squirrels themselves were very quiet and shy and were seldom observed, and not a single sound was heard which could be attributed to them. I hunted carefully for the larger part of a day before catching sight of one, and then secured two fine brown males, two black males, and one black female. These specimens are in beautiful long and silky winter pelage, and the ear tufts are of maximum length. The fur of melanistic specimens is of fine quality, and were the squirrels numerous it would undoubtedly be in great demand.

The nests are nearly always constructed of pine needles and lined with strips of the inner bark of the pine. In the Eastonville region I found *S. ferreus* living entirely in open nests, but near Bradford it is said often to take up its abode in hollow pines and even in hollow cottonwoods (*Populus angustifolia*).

This squirrel is one of the most striking examples of extreme melanism among mammals. Of the 24 specimens in the Biological Survey and National Museum collections, including the type, 19 are melanistic (either black or dark brown) and 5 are gray. A man who had hunted in the Estes Park region for a great many years informed Streator in 1894 that out of nearly 100 of these squirrels which he had seen or killed only 1 was gray. This ratio is, of course, much too high, but it is certain that melanistic individuals preponderate in most sections. Near Eastonville I saw no squirrels in the gray phase, nor could I learn of any having been seen there. Mr. C. E. Aiken states, however, that in a batch of nearly 150 skins of *S. ferreus* which he purchased many years ago from the region between Monument and Eastonville, the black phase was most common and the brown phase next, while there were a very few gray skins. An odd skull, which I secured at Bailey, belonged to a black squirrel. On the slopes of the Sangre de Cristo Range the gray phase seems to be more common than elsewhere, and no black squirrels were reported from the Mosca and Medano Passes.

Sciurus aberti mimus Merriam. Tuft-eared Squirrel.

So far as known, this large, handsome squirrel occurs in Colorado only in the extensive yellow pine forests which clothe the lower slopes of the San Juan and La Plata Mountains, in Conejos, Archuleta, La Plata, Montezuma, and Dolores Counties, in the Transition zone. (See fig. 2.) The center of abundance appears to be the Pagosa Springs region, Archuleta County, between 7,000 and 7,500 feet.

Tuft-eared squirrels are commonly reported from the upper valley of the Los Piños and along Vallecito Creek, in northeastern La Plata County, and are found sparingly to the lower edge of the pine belt a few miles north of Bayfield, but are said never to range down into the pinyon country. The species has been recorded from Florida, La Plata County, by Allen.[1] One was noted at 8,200 feet in the upper edge of the yellow pine belt on the southwest slope of Pagosa Peak. Mr. Steve Elkins, of Mancos, states that a few of these squirrels inhabit the pine forests at the western base of the La Plata Mountains, and their range extends a short distance out on the Dolores Plateau, northeast of Dolores. In crossing this plateau between Dolores and the Lone Mesa late in June, 1907, I saw no signs of squirrels, but learned from Forest Ranger James Lowell that they are present in small numbers. The Dolores Plateau appears to mark the northern limit of the range, as none were found in the yellow pine forests which clothe much of the San Miguel Plateau, the northern slopes of the San Miguel Mountains, and the Uncompahgre Plateau. Vernon Bailey says this squirrel was reported to him as common in the eastern foothills of the San Juan Mountains, 10 miles west of Antonito, Conejos County, in August, 1904. This is the only record of its occurrence in Colorado east of the Continental Divide. On the east side of the San Luis Valley, and along the eastern slopes of the front ranges, this form is replaced by *S. a. ferreus.*

This squirrel is characteristic of the stately yellow pine forests near Pagosa Springs and in the open vistas can be seen at a considerable distance. It is often first detected on the ground, moving about among the pine cones which carpet the forest floor in many places. When alarmed, it lopes leisurely up to the base of a pine, usually the nest tree, which it seems reluctant to climb, barking and scolding at the intruder until approached somewhat closely. When thoroughly frightened, it betakes itself to the higher branches, and its claws make a very audible sound on the dry bark. When seated motionless on an exposed limb far up in a big pine, this squirrel presents an odd appearance, due to its long hairy ear tufts. Once safely within the confines of the nest tree it will occasionally scamper part way down the trunk in a daring fashion, chattering excitedly. In climbing up or down a tree it spreads its feet far apart and by its flat appearance reminds one strongly of a flying squirrel.

The nest tree—usually a large dead pine with a hollow sufficiently large for the squirrels' home—is generally located in the heaviest forest, and very few of the animals live in small timber or along the outskirts of the forest. A few nests, composed largely of dry pine needles, were seen in the upper branches of large pines, but most of the squirrels appeared to be living in hollow trees. A stomach examined at Pagosa Springs contained a mass of finely masticated green material which could not be identified with certainty, but probably consisted of the inner bark of the terminal branches of the yellow pine. One squirrel was seen gnawing the bark from a good-sized limb, apparently feeding. The many freshly cut tips of terminal branches beneath the pines in the neighborhood of the nest trees attest to the squirrels' activities.

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[1] Bull. Am. Mus. Nat. Hist., V, p. 83, 1893.

In the silence of the vast forest reaches, the calls of this squirrel are at times the only sounds which reach the ear. During rainy or inclement weather, however, the squirrels are inactive and the calls rarely heard. The soft bark, sometimes sounding like wuh, wuh, wuh, and again like chuck, chuck, chuck, is usually repeated three or four times at short intervals, and each call is accompanied by a jerk of the tail. These squirrels are occasionally kept in confinement and are said to make desirable pets.

In a series of four males and two females collected a few miles west of Pagosa Springs, May 29, 1907, two were only about two-thirds grown. Fully half the squirrels noted here during the last week in May were immature, easily distinguishable on a tree by a dark-colored area in the middle of the dorsum. In adults this area is generally reddish.

Sciurus fremonti Aud. and Bach. Fremont Squirrel; Chickaree.

Sciurus fremonti Audubon and Bachman, Quad. N. Am., III, p. 237, 1853. Type from "Rocky Mountains" (probably from the Park region of central Colorado).[1]

The Fremont squirrel lives in the coniferous forests throughout the mountains of Colorado, and ranges from the upper edge of the yellow pine belt to timberline. (See fig. 3.) It is typical in the Canadian zone of the main ranges, but on the western plateaus becomes slightly reddish on the rump and upper surface of the tail, as shown by a large series of specimens from various localities. This squirrel is usually common wherever found, and its lively, cheering chatter is one of the few sounds which break the silence of the high mountain forests. On the main ranges it occurs chiefly in the forests of lodgepole pine and Engelmann spruce, but in the southern mountains is perhaps more common in the forests of white fir (*Abies concolor*), while on the western plateaus it frequents the more open growth of Douglas spruce on the summits and upper northern slopes. In the Escalante Hills this squirrel is reported to come down among the yellow pines, at 7,000 feet, during the winter, and in a great many sections I have found it along the extreme upper edge of the Transition zone, at 8,500 feet, where pockets of balsam and aspen are scattered among the yellow pines. I shot one individual in the Upper Sonoran zone, at 6,000 feet, on Tabeguache Creek, 8 miles north of Nucla, Montrose County. It was in almost the last yellow pine found along the creek, at a point where the canyon sides were clothed with junipers and piñyons, but really within a short distance of the Canadian zone forests.

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[1] So considered by Dr. J. A. Allen, who treats the matter in detail in Bull. Am. Mus. Nat. Hist., X, pp. 289-290, 1898. Dr. Allen's conclusion that the type specimen of *fremonti* (in the collection of the Philadelphia Academy of Natural Sciences) was not collected near South Pass, Wyo., as had been previously supposed, is confirmed by specimens in the Biological Survey collection. Large series of squirrels from the Wind River Mountains, near South Pass, and also from the Green, Ferris, and Laramie Mountains to the east and south, are quite distinct from *fremonti*, being referable to the northern *S. hudsonicus* group.

Like the common northern red squirrel, which it greatly resembles in all respects except color, *S. fremonti* feeds chiefly upon pine and spruce cones, which are hoarded in large caches at the bases of trees, beneath logs, and among rocks. I have never found it living in a hollow tree, although it may do so occasionally. The nests of pine or spruce needles and fine strips of bark are usually constructed in the fork of a branch well out from the main trunk, at from 20 to 40 feet above the ground, and in the densest forest. I have found the nests occupied by the squirrels in both summer and winter. This squirrel is not at all shy, and may be coaxed to within a few feet by making a nondescript "screeping" noise. One seen by Mr. Morris M. Green, near Almont, in August, 1909, was laboriously ascending a tree, carrying a large cantaloupe rind, which had been left by a camper. In some localities it is called the little gray squirrel, which is, of course, a misnomer, as it is subgenerically different from the gray squirrels and its color is olive brown.

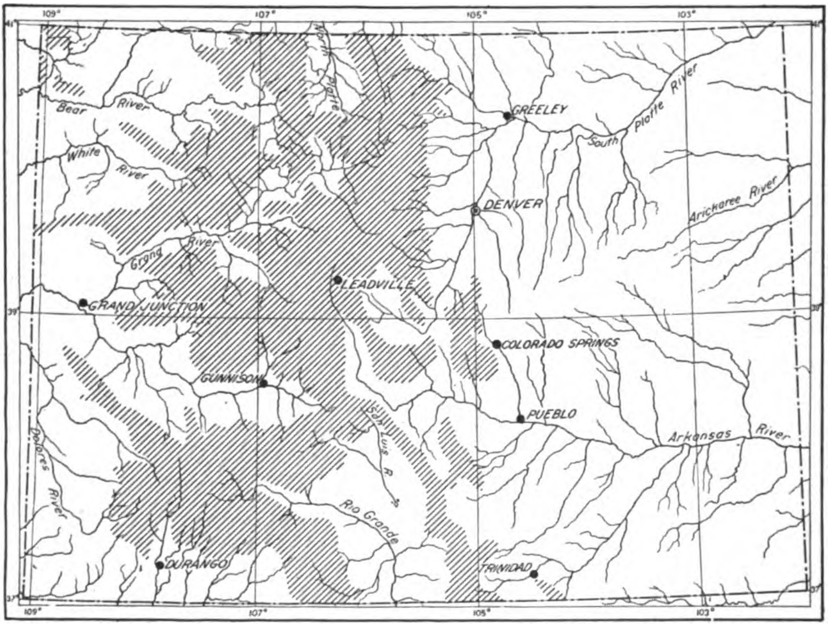

FIG. 3.—Distribution in Colorado of Fremont squirrel (*Sciurus fremonti*).

(?) **Sciurus fremonti neomexicanus** Allen. New Mexico Chickaree.

It is not certain that *neomexicanus* occurs within the State, but it has been taken at Costilla Pass and Bear Canyon, New Mexico, both localities within a few miles of the Colorado boundary. A. H.

Howell thinks that a squirrel which he saw among the pinyons near Trinidad in September, 1903, was this reddish form of *S. fremonti*; while others seen by Mr. J. H. Gaut on the Conejos River, 12 miles west of Antonito, may have been *neomexicanus*. Unfortunately, there are no specimens from along the southern edge of the State, and the identity of the squirrels found in the southern San Juan and Culebra Mountains can be decided only by future investigations.

Eutamias quadrivittatus (Say). Say Chipmunk.

Sciurus quadrivittatus Say, in Long's Exped. Rocky Mts., II, p. 45, 1823. Type from Arkansas River, about 26 miles below Canon City, Colorado.

This large chipmunk, the four-lined squirrel of Say, was described from a specimen taken by Maj. Long's party at a point on the Arkansas River about 30 miles below the place where the river leaves the mountains, July 17 or 18, 1820. This point, as Dr. Merriam has already shown,[1] was probably about 26 miles below Canon City. The species has its center of abundance in the yellow pine belt of the Transition zone in the eastern foothill region, where it ranges nearly across the State from north to south. In Larimer County its known range is restricted to the lower eastern slopes of the Medicine Bow Mountains south of Arkins. Farther south, *E. quadrivittatus* has a wide distribution within its zonal limits, and is occasionally taken in the Canadian and Upper Sonoran zones. In the southern tier of counties it extends east to the western edge of Baca County[2] and west to La Plata County. The western limits may be roughly indicated by Florida and Bayfield, La Plata County; Silverton; Sapinero; St. Elmo, Saguache Mountains; near McCoy, Eagle County; Grand Lake; and Medicine Bow Range. (See fig. 4.) A large series of specimens from Canon City (near the type locality) and from a great many localities over the range of this species are in the Biological Survey collection.

West of the Front and Saguache Ranges I have taken this species at only one locality, Sapinero, in the valley of the Gunnison, at 7,300 feet, but it has been collected at Sulphur Springs, Grand Lake, near Sheephorn Pass, and near McCoy, as recorded by Warren.[3] In extreme southern Colorado *quadrivittatus* is found in the foothills bordering the San Luis Valley and is common west of the Continental Divide, being especially numerous in the yellow pine forests of Archuleta and La Plata Counties, on the southern slope of the San Juans. In this region it is not uncommon in the pinyon belt, as at Arboles and south of Bayfield, and was not seen above 7,500 or 8,000 feet north of Pagosa Springs or in the Vallecito region. This chipmunk has, however, been taken at Silverton (9,000 feet). West of the La Plata Mountains, and apparently west of their southern extension, it is replaced by the Hopi chipmunk (*E. hopiensis*). The limits of these two species along the San Juan River have not been ascertained, but it is quite possible the ranges meet, as at McCoy, on the upper Grand River.

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[1] Proc. Biol. Soc. Wash., XVIII, p. 163, 1905.

[2] The Baca County chipmunks have been recently separated as a pale race by E. R. Warren (Proc. Biol. Soc. Wash., XXII, p. 105, 1909).

[3] Further Notes on the Mammals of Colorado, Colo. College Pub., gen. ser. no. 33, p. 68, 1908.

At Sapinero, in mid-October, 1907, *E. m. consobrinus* was the only chipmunk seen alive, but October 15 three specimens of *quadrivittatus* got into my mousetraps along the rocky ledges of a gulch extending from the Gunnison River up through the sagebrush slopes southwest of the town. The species doubtless reaches the Gunnison region from San Luis Valley by way of Cochetopa Pass, rather than across the high Saguache Range, since at St. Elmo, on the east side of this range, it was not observed in the Hudsonian and Arctic-Alpine zones, although tolerably common in the Chalk Creek Valley, at 10,000 feet. In the Upper Arkansas Valley it is abundant to a short distance above Buena Vista. At Como, in South Park, several were seen on the timbered ridges at 10,000 feet, one being noted in the upper branches of a foxtail pine (*Pinus aristata*).

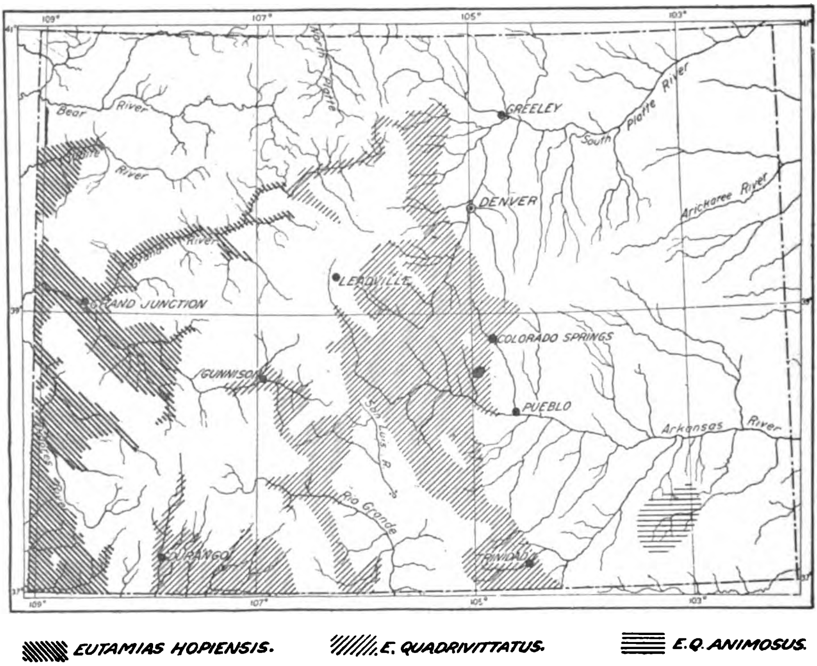

FIG. 4.—Distribution in Colorado of Hopi, Say, and Las Animas chipmunks (*Eutamias hopiensis*, *E. quadrivittatus*, and *E. q. animosus*).

E. quadrivittatus is the largest and best known of the Colorado chipmunks, and is the one commonly seen along the eastern base of the foothills. At several localities, notably at Colorado Springs and

Boulder, the ranges of this species and the smaller *operarius* of the boreal zones overlap for a vertical distance of nearly 3,000 feet. The two chipmunks are easily confused in life, as the coloration is very similar, but *quadrivittatus* is considerably larger and slightly brighter in color. Like most chipmunks, this species is out in greatest abundance during the early morning hours or late in the afternoon, and may be seen frisking about the rocks and stumps of trees on the sides of canyons or along fences or busily feeding in the thickets of wild cherry and June berry so abundant in the canyon bottoms. It is usually shy, and when surprised hastily takes refuge among the rocks, uttering high-pitched, chippering notes. The ordinary note, however, is a soft chuck, chuck, usually uttered when the animal is at a distance from the observer and either sitting on the summit of a large rock far up the canyon side or on a tree stump in the silence of the yellow pine forest.

The food consists chiefly of seeds of various weeds and grasses and of *Cercocarpus parvifolius*, the fruit of the prickly pear (*Opuntia*), and also juniper berries, currants, wild cherries, and June berries. In autumn this chipmunk gathers a winter's supply of food, hoards it in crevices and under rocks, and goes into at least partial hibernation over most of its range, according to the length and severity of the winter. It is often out in mild winter weather.

Eutamias quadrivittatus animosus Warren. Las Animas Chipmunk.

Eutamias quadrivittatus animosus Warren, Proc. Biol. Soc. Wash., XXII, pp. 105–106, June 25, 1909. Type from Irwin's ranch, Las Animas County, Colorado.

The range of this large pale race of *E. quadrivittatus* is imperfectly known. Warren based his description upon three specimens, all taken by himself in the rough Upper Sonoran juniper country of northwestern Baca and northeastern Las Animas Counties, at elevations of about 5,000 feet. The first specimen he secured in the spring of 1905, at Gaume's ranch, Shell Rock Canyon, in the northwest corner of Baca County. No more specimens were known until April, 1909, when Warren made another trip to the region and collected two more at Irwin's ranch, in Las Animas County, some 12 miles west of Gaume's ranch. (See fig. 4.)

In late November, 1907, I made a trip to Gaume's ranch, but failed to see any chipmunks, as they were already in hibernation. They were reported to be common, however, in the juniper country of that section. Although the two localities at which specimens have been taken are close together, it seems probable that this pale chipmunk will be found to occupy most, if not all, of the rough juniper and pinyon country of Las Animas and western Baca Counties, locally known as The Cedars. It is reasonably certain that *animosus* is confined to the Upper Sonoran area east of the foothills. Chipmunks which I saw at Walsenburg were fully as dark as typical *quadrivittatus*, while Trinidad specimens more nearly agree with those from Archuleta and La Plata Counties in being more brightly colored than typical specimens and having the white dorsal stripes wider and purer white.

Eutamias hopiensis Merriam. Hopi Chipmunk.

This handsome species is represented from Colorado by a series of specimens from White River, near Angora; Rangely, 20 miles southwest; Evacuation Creek, north base of Book Plateau; Rifle; Dotsero, Grand River Canyon; McCoy; Somerset; Coventry; Uranium, Sinbad Valley; and Spruce Tree Cliff Ruins, Mesa Verde.

I first met with the Hopi chipmunk among the rocky bluffs at the ford of White River, near Angora, September 12, 1906. At this point fully a dozen were actively engaged in carrying oats from a stack along the river and storing them in caches among the rocky ledges near by. Numbers were seen among the White River bluffs as far west as Rangely, and thence the range is continuous across the rough juniper country to Dragon Junction, Utah, and southeast in the valley of Evacuation Creek to the north base of the Book Plateau, at 7,000 feet. This chipmunk doubtless occurs in all of the country between the Book Plateau and White River and west of Cathedral Bluffs. On the Book Plateau it was again found on the southern slope near Atchee, at 7,000 feet, which is very near the upper limit of junipers and pinyons. Thence it ranges south to Grand River and northeast in the Grand Valley uninterruptedly to the western end of Gore Canyon. It appears not to extend through this rugged gorge, however, as it was not found at Kremmling, Middle Park. It is very abundant in the lower valley of Plateau Creek, and occurs sparingly on the warm juniper slopes north of the Eagle River Valley nearly to Wolcott, where the Transition zone country proves an effective barrier to its eastward extension.

South of Grand River the Hopi chipmunk reaches its eastern limit at the following localities: Basalt, at the junction of the Frying Pan and Roaring Fork Rivers; Somerset, on the North Fork of the Gunnison; Crawford, on the Smith Fork of the Gunnison; pinyon slopes north of Dallas Creek, 5 miles west of Ridgway; Placerville,[1] on the San Miguel River; Cortez, in the Montezuma Valley; and the Spruce Tree Cliff Ruins, at the head of Navajo Canyon, which breaks to the south from the Mesa Verde into the canyon of Mancos River, a tributary of the San Juan. It was not found in the Durango region or at Arboles, and apparently does not follow the San Juan Valley east of the low divide extending south from the La Plata Mountains. In the warm valleys and canyons of western Mesa, Montrose, and

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[1] Warren, Further Notes on the Mammals of Colorado, p. 68, 1908.

San Miguel Counties *hopiensis* is abundant up to 7,000 feet, and was noted at the following localities: Coventry; Naturita Valley, 3 miles east of Naturita; Tabeguache Canyon, north of Nucla; west rim of West Paradox Valley up to the lower edge of the yellow pines, at 7,000 feet; Sinbad Valley and surrounding rim; Salt Canyon; Dolores Canyon to mouth of West Creek; and 4 miles up the valley of West Creek. It apparently does not extend through the northern end of the Uncompahgre Plateau in the Unaweep Canyon; and since at all other points the Canadian zone cap of this plateau is an effectual barrier, it must reach the Uncompahgre Valley, on the east side of the plateau, from the north, through the Grand and Gunnison Valleys.

The Hopi chipmunk is common in western and southern Montezuma County, where I have seen it in the McElmo Canyon at Ashbaugh's ranch and Moqui, and in the southern borders of the Mesa Verde. At the head of Navajo Canyon these chipmunks were abundant the middle of June. They frequented the cliffs along the warm side of the canyon during the early morning hours, and were usually seen running along the rocky ledges in the bright sunlight in family groups of four or five, the young being from half to two-thirds grown. About 9 o'clock the chipmunks usually disappeared and were not again seen until the following morning. A nursing female in worn pelage and a male in bright fresh summer coat were collected at this point.

Eutamias hopiensis was described from Keam Canyon, Painted Desert, Arizona, and is known also from Bluff City, Utah, and a number of localities in the San Juan Valley of northwestern New Mexico. Its range has not been worked out in detail, but is known to be in the desert canyons and pinyon and juniper country bordering the Colorado River and its tributaries from northern Arizona and northwestern New Mexico north to northwestern Colorado, mainly in the Upper Sonoran zone. It occurs in Colorado at few points above 7,000 feet.

As far as known the ranges of *E. hopiensis* and *quadrivittatus* meet at only one point in Colorado (see fig. 4). E. R. Warren collected both species in May, 1907, at Yarmany Creek, near McCoy, Eagle County, at an elevation of 6,900 feet,[1] and the specimens, which I have examined, show no evidence of intergradation. The two species occur in close proximity elsewhere. I have taken *E. quadrivittatus* at Sapinero and have seen *hopiensis* at Crawford.

In size and general appearance the Hopi chipmunk resembles *E. quadrivittatus* of the eastern foothills, but its movements are more deliberate and its colors much brighter and richer. The long tail is carried more nearly horizontally, even when the animal is running. This striking habit, together with the graceful downward curve of the tail near the tip, serves to distinguish it, even at a distance, from the small *E. consobrinus*, with which it commingles in the higher parts of its range. In the juniper country south of White River its habit of leaping up a tree when alarmed and hiding on the opposite side of a branch may cause it to be confused with the gray *utahensis*, which is found in similar country in the Escalante Hills. The Hopi chipmunks appear equally at home among the hot rocks in the precipitous canyons and in the dense juniper and pinyon growth which clothes the bordering mesas. They feed extensively upon the berries of *Juniperus monosperma* throughout their range.

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[1] Further Notes on the Mammals of Colorado, p. 68, 1908.

Eutamias amœnus operarius Merriam. Colorado Chipmunk.

Eutamias amœnus operarius Merriam, Proc. Biol. Soc. Wash., XVIII, p. 164, June 29, 1905. Type from Gold Hill, Boulder County, Colorado.

This chipmunk was formerly confounded with *quadrivittatus*, with which it occurs at many points in the eastern foothills of Colorado; but while the two are nearly alike in coloration, *operarius* is decidedly smaller, and its short, round skull and short nasals indicate affinities with a different group. The rump is usually ashy gray, while that of *quadrivittatus* is olivaceous. From *consobrinus* of the western mountains *operarius* may be distinguished by its more robust skull, although in summer pelage the two are sometimes almost indistinguishable externally. It is the highest ranging chipmunk in the State, occurring regularly far above timberline along the crest of the front ranges. It is found also as low as 6,500 feet at several localities in the eastern foothills, and E. R. Warren has recently shown me specimens taken by Robert B. Rockwell along the South Platte, 3 miles south of Littleton, at about 5,300 feet.

Although most abundant on the higher slopes of the front ranges, *operarius* is common in the mountains bordering the San Luis Valley and extends westward in the San Juan Mountains to Silverton and Lake City, where fairly typical specimens have been taken. A June specimen from the southeast base of Lone Mesa, west of the La Plata Mountains, seems referable to *operarius*, although the only other chipmunk taken at that locality is nearer *consobrinus*. A very brightly colored July specimen taken in the yellow pine country at the head of Dominguez Creek, on the Uncompahgre Plateau, is intermediate, resembling *consobrinus* externally. *E. operarius* was abundant in the high La Sal Mountains, Utah, west of the Paradox Valley, in July, 1907, at 11,000 feet, and was seen considerably above timberline. The chipmunks of the La Sal Mountains are entirely isolated from those of the Colorado mountains by a broad belt of Upper Sonoran desert country occupied, so far as known, by only *E. hopiensis*.

The extent of country over which the ranges of *operarius* and *consobrinus* overlap has not been worked out with precision. Both forms have been taken at Canadian Creek, at the west base of the Medicine Bow Range in North Park; at Coulter, Middle Park; and at Lone Mesa (9,000 feet), west of the La Plata Mountains. Chipmunks from Sapinero are typical *consobrinus,* while others from Lake City, 35 miles south, are *operarius.* Specimens collected above timberline on the Saguache Mountains at St. Elmo are, strangely enough, *consobrinus,* indicating that *operarius* is not found on the west side of the Arkansas Valley. Chipmunks taken by Warren on the head of Eagle River (near Tennessee Pass) are intermediate but nearest *operarius.*

Average measurements of five skulls of adult male topotypes of *E. operarius* are as follows: Occipito-nasal length, 32; basilar length, 24.6; zygomatic breadth, 18. Average of four skulls of adult male *consobrinus* from Canadian Creek, North Park: Occipito-nasal length, 31; basilar length, 23.5; zygomatic breadth, 17.2.

There are specimens of *operarius* in the Biological Survey collection from the following localities: Gold Hill, type locality; Estes Park; Longs Peak; Boulder, 5 miles west; Nederland; Golden; Idaho Springs; Cascade; Mount Kelso; Elkhorn; Livermore; Berthoud Pass; Canadian Creek; Coulter; Como; Lone Mesa; La Sal Mountains, Utah; Silverton; Lake City; Hermit; Cumbres; Antonito; and Fort Garland. Warren has specimens from Colorado Springs; Florissant; Tarryall Creek; Salida; Boreas Pass, 11,470 feet; Breckenridge; Poncha Pass; Herard; Querida; Crestone; and Tercio, Las Animas County.

Eutamias minimus (Bachman). Least Chipmunk.

Chipmunks from the Snake River Valley and the adjacent sage plains and from the Browns Park region along Green River agree well with typical *E. minimus* from Green River, Wyoming. In the region between Bear River and the Danforth Hills, *minimus* grades into the dark form *consobrinus* of the high mountainous country on the south and east. Four August and September specimens from Snake River (20 miles west of Baggs Crossing), Sunny Peak, and Ladore are typical *minimus.* Others from Lay, Axial Basin, and Lily show an approach to *consobrinus.*

The least chipmunk is one of the most characteristic mammals of the sage plains and appears not to range at any point much above 6,000 feet. During the latter part of August, 1906, numbers were observed in the Snake River Valley near Sunny Peak, Routt County. Some were in dry arroyos or on the level sage plain, but the majority were busily engaged in gathering a winter's supply of buffalo berries (*Lepargyrea argentea*), which were fully ripe in the dense thickets along the river. Near Ladore, in the Green River Valley, this chipmunk was often seen in the tops of *Sarcobatus* bushes. On the north slopes of the Escalante Hills it ranges up to the edge of the junipers and pinyons inhabited by the large gray *Eutamias utahensis,* but apparently does not enter the timber growth. This chipmunk may often be seen in the top of a sagebush, but unlike *E. consobrinus* is very wild and difficult to capture. When running, it holds its tail at right angles to the back. The tail then appears very long, but this may be partly due to the small size of the body.

Eutamias minimus caryi Merriam. San Luis Chipmunk.

Eutamias minimus caryi Merriam, Proc. Biol. Soc. Wash., XXI, p. 143, June 9, 1908. Type from Medano ranch, San Luis Valley, Colorado.

So far as known, this handsome ashy gray chipmunk is restricted to the eastern and northern central parts of San Luis Valley, where it inhabits the open *Sarcobatus* and *Chrysothamnus* plains. The original series of specimens from the Medano Springs ranch, east of the San Luis Lakes, consists of 8 males and 5 females collected October 24–29, 1907. In the summer of 1909 Warren found it at Moffat, Hooper, Mosca, and Crestone, thus considerably extending the known range. Chipmunks reported from the greasewood plains between Moffat and Saguache are doubtless the same form, and suggest a very general dispersion over the central part of the valley. At the time of my stage trip between these two points, November 6, 1907, the chipmunks had apparently retired to winter quarters. I heard of none at Alamosa or at any point in the open valley south of Mosca.

This chipmunk strongly resembles *E. minimus* of the Routt County sage plains, its nearest relative, as regards both wariness and appearance. When the animal is running, the tail is carried at a right angle to the back, and appears much longer in proportion to the body than measurements show it to be. At the Medano ranch these chipmunks were usually seen among the low sandy hummocks and ridges bordering the meadows, where the chico brush or chaparral of *Sarcobatus vermiculatus*, *Chrysothamnus patens*, and *Atriplex occidentalis* reaches its maximum growth, often from 6 to 8 feet in height, and affords suitable homes and retreats among the gnarled and many branched roots and basal stems which the drifting sands have left partially exposed. Most of my specimens were shot, but a few were caught in mousetraps. The chipmunks were out chiefly during the forenoon, and any time after sunrise on bright mornings could be seen in the tops of the chico brush busily storing the seeds in their cheek pouches, afterwards descending and caching them in the burrows, which were usually in the sand at the bases of the shrubs. One usually noted my approach at a distance of fully 50 yards, and, after hastily climbing to the top of a tall bush for a good look, would descend to the ground, sometimes silently, and again uttering excited, high-pitched notes. When the little fellow next appeared above the level of the chico it was generally in a tall bush fully 30 yards farther on. This maneuvering would be kept up for some time until a very large bush would conveniently intervene and afford sufficient cover to approach within range. The chipmunks were silent for the most part, and the alarm notes were heard only a few times. The notes are not loud, but are very high pitched, and quite unlike those of *quadrivittatus* and *operarius* of the foothills and mountains on both sides of the valley. The size, coloration, and habits readily distinguish this chipmunk from either of the above forms. Cowboys at the Medano ranch state that, in addition to the chico seeds, these chipmunks are very fond of the large roundish seeds of a honey plant (*Peritoma sonoræ*), locally known as skunk weed, which grows rankly on the dry sandy ridges extending through the meadows.

Eutamias caryi is characterized as follows (from original description, l. c.):

"*Characters.*—Similar to *minimus* but paler and grayer. In fall pelage (late October) pale gray, most marked on neck and rump, and almost as clear on inner pair of light stripes; outer pair of white stripes purer white than in *minimus*; pale face stripes whitish, in striking contrast with the alternating dark stripes.

"*Measurements.*—Type: Total length, 194; tail vertebræ, 87; hind foot, 30. Average of 10 specimens from type locality: Total length, 194; tail vertebræ, 89; hind foot, 30.2."

Eutamias minimus consobrinus (Allen). Wasatch Chipmunk.

This is the small, brightly colored chipmunk so abundant in the Canadian and Transition zones on the mountains and plateaus west of the Front and Medicine Bow Ranges and north of Grand River. It is present also on some of the plateaus and mesas of the southwestern counties, where it frequents the oak chaparral, ranging at least as far south as the Mesa Verde and Ute Peak. In eastern Middle and North Parks and on the western slope of the La Plata Mountains its range meets and slightly overlaps that of *operarius* and, as noted under *operarius*, both forms have been taken together at several localities. On some of the western plateaus *consobrinus* ranges a short distance into the pinyon belt of the Upper Sonoran zone, where over small areas in the Grand, White, and North Gunnison Valleys, and in the San Miguel region, it commingles with the large Hopi chipmunk (*E. hopiensis*). Toward the north, on the sage plains of Routt County, it grades into *minimus*. Its center of abundance is in the heavy forests of the Canadian zone, but it is common on the high sage plains of North Park, and even ranges into the greasewood in some of the warm Upper Sonoran valleys in the extreme western part of the State. It is especially numerous in the Gunnison region, on the White River Plateau, and in the mountains bordering North and Middle Parks, except on the east side.

E. consobrinus generally remains below the Hudsonian zone and, broadly speaking, it is not such a high ranging form as *operarius*.

Near St. Elmo, in the Saguache Mountains, however, it was tolerably common at timberline October 9, 1907, while down in the Chalk Creek Valley at St. Elmo (10,000 feet) none were noted. Most of the chipmunks seen were running actively over the snow banks in the ragged growth of foxtail pines (*Pinus aristata*) just below timberline. Seen at a distance on the bright snow banks, with their tails held erect, these chipmunks are striking little objects. Three specimens were shot at an altitude of 12,000 feet.

The sharp notes of this chipmunk are characteristic sounds in the depths of the aspen and spruce forests. Deserted cabins are especially frequented by them, and near a camp the chipmunks soon become tame and unsuspecting. In the latter part of September, 1906, from 20 to 30 could often be counted within sight of our camp at Baxter Pass, at 8,000 feet, on the Book Plateau, where they were busily gathering acorns. They were rarely observed during the middle of the day, being out chiefly in the early morning hours. In the high country the food consists largely of wild cherries, June berries, and snowberries (*Symphoricarpos oreophilus*). In the White River Valley in September they were feeding extensively upon buffalo berries (*Lepargyrea argentea*).

A large series of specimens from the following localities indicates the range of *consobrinus* in Colorado: Coulter; Sulphur Springs; Kremmling; Mount Whiteley; Arapahoe Pass; Canadian Creek; Pearl; Elk Head Mountains; Meeker; White River Plateau; Rangely; Evacuation Creek; Baxter Pass, Book Plateau; Gypsum; Sapinero; Somerset; Mesa Verde; and Lone Mesa.

Allen has recorded (as *Tamias quadrivittatus*) a series of 16 chipmunks collected by W. W. Granger at Three Forks (forks of Snake River, near Honnold) in 1895.[1] Specimens in the Biological Survey collection from 5 miles south of Honnold are *consobrinus*, and that Mr. Granger's series is referable to the same form is indicated by the small hind foot measurements given—29.5 to 30.7.

Eutamias dorsalis utahensis Merriam. Utah Chipmunk.

Fifteen specimens of this handsome gray chipmunk were collected in the dense juniper and pinyon growth on the northern slopes of the Escalante Hills, at Douglas Spring, early in September, 1906, but it was not taken elsewhere in western Colorado, although much of the region seems favorable for it. These chipmunks were abundant in the heavy growth of junipers and pinyons between 6,000 and 6,500 feet, and were found also in rocky ledges among the scattered yellow pines on the summits at 7,000 feet. Warren collected this species on Cross Mountain, east of Snake River, a few miles northeast of Lily, in 1907. This locality is some 20 miles east of Douglas Spring.

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[1] Bull. Am. Mus. Nat. Hist., VIII, p. 256, 1896.

It is reported also from the eastern end of Yampa Canyon, a few miles west of Lily.

Eutamias utahensis was described from Ogden, Utah, and has not been previously taken much east of Provo in that State. It is an Upper Sonoran form and probably ranges eastward along the southern foothills of the Uinta Mountains, entering Colorado in the region of the Yampa Plateau, south of Bear River. Future work in northeastern Utah will determine whether there is continuity of range or the Colorado colony is entirely isolated.

These chipmunks at Douglas Spring were remarkably wild, and it required much perseverance to secure my series of specimens, all of which were shot. The favorite feeding time was in the early morning and again just before sunset, when they were usually in the tops of junipers busily feasting upon the berries. I seldom managed to approach nearer than 30 yards without alarming them. When frightened they uttered a series of high-pitched notes, and after a hasty descent to the ground fled precipitately, rarely stopping within sight. The bushy tail is very prominent and gives the animal the appearance of a small squirrel, and this resemblance is heightened by the ease and rapidity with which it climbs trees and keeps on the opposite side from the observer. The seeds of the juniper berry appear to be the chief food, and they filled the cheek pouches of the specimens collected. Several caches of these berries were found in the hollow branches of junipers in which the chipmunks appeared to be living.

Callospermophilus lateralis (Say). Say Ground Squirrel.

S[*ciurus*] *lateralis* Say, in Long's Exped. Rocky Mts., II, p. 46, 1823. Type from Arkansas River (a few miles below present site of Canon City), Colorado.

The Say ground squirrel is a common and characteristic mammal throughout the mountains of Colorado in the Transition and Canadian zones. It is found from the eastern bases of the foothills to timberline and west of the main ranges occurs on all the timbered hills and plateaus to the Utah boundary. The Biological Survey collection is rich in specimens of this species from a great many localities over its range. *C. lateralis* is replaced in the rocky canyons and juniper country along Bear and Snake Rivers by a pale form, *C. l. wortmani.* Specimens from the Transition zone summits of the Escalante Hills, in extreme western Routt County, are nearest *lateralis.* Others from the White River Valley near Rangely are noticeably paler than typical specimens from the eastern foothills and approach *wortmani.* (See fig. 5.)

In the foothills near Boulder *C. lateralis* is most abundant in the yellow pine belt between 5,500 and 8,500 feet, but in crossing the mountains from Fort Collins to North Park it was first noted in the lower edge of the lodgepole pine belt a few miles northeast of Bald Mountain at 8,500 feet. From this point it was common across the Laramie Divide, Laramie Valley, and Medicine Bow Range to the edge of the sage plains of North Park. At Arapahoe Pass (Rabbit Ear Mountains), and on the White River Plateau, southeast of Meeker, *lateralis* was common in the aspen and lodgepole pine forests at 9,000 feet, and was especially numerous about clearings and among the charred stumps and logs in fire-swept tracts. Farther west, on the Book Plateau, it was common on the open rocky south slope as far down as Carbonera, at the edge of the Grand Valley, and was also observed in the valley of Evacuation Creek at the north base of the plateau.

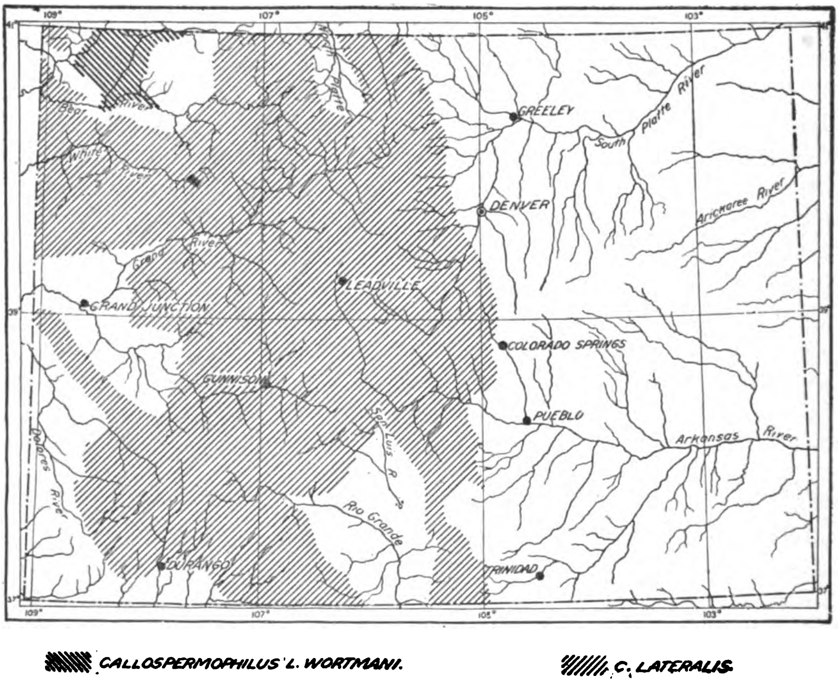

FIG. 5.—Distribution in Colorado of golden-mantled ground squirrels (genus *Callospermophilus*).

In the southern part of the State the Say ground squirrel is most abundant in the Transition zone—in the extensive yellow pine forests at the southern base of the San Juan Mountains from Pagosa Springs west to Vallecito; on the Dolores and Uncompahgre Plateaus; and at the north base of the San Miguel Mountains, south of Norwood. It has a wide zonal range, however, from the lower edge of the pines to timberline, and at Mancos, at least, is abundant in the upper edge of the pinyon country. One was noted on a pinyon-clad slope a few miles west of Ridgway, Ouray County.

This ground squirrel usually lives in rocky ledges and among piles of bowlders, but in the heavy forests often digs its own burrow or takes up its abode in a hollow log or deserted cabin. In the sandy yellow pine country at the head of Dominguez Creek on the Uncompahgre Plateau it appeared to be living entirely in burrows, and in some places in the higher parts of its range it uses so constantly the tunnels of the mountain pocket gopher (*Thomomys fossor*) that it is continually getting into traps set for gophers. Near Cochetopa Pass Loring once found one living in a burrow which it had excavated in the earth roof of a cabin. It is fond of sunning itself in exposed situations during the warmer part of the day, and may often be seen sitting upright and motionless on a point of rocks, tree stump, or ridge pole of a cabin. The animals are rarely observed on cloudy days, and they do not come out so early in the morning as the chipmunks do, but await the warming rays of the sun. Several families of this species were living in the slide rock near the Stevens Mill, at timberline on Mount McClellan, in June, 1905. Each morning during my stay, at about 9 o'clock, they were busily feeding, in company with chipmunks and white-throated sparrows, on the oats left in the trail in front of the mill by the ore teams. At Estes Park, in August, 1894, Dr. A. K. Fisher found this species feeding extensively upon currants (*Ribes cereum*). In southern Colorado acorns form a part of its food. Warren states that near Querida it has been seen to kill a young bluebird in a nest in the bank of a gulch, apparently with the intention of eating it.

Near Georgetown, June 25, 1905, I saw a female and two young about a third grown romping among some loose rocks on the bank of Clear Creek. When the old squirrel first saw me she ran to the little ones and pushed them back into a hole among the rocks with her forefeet. As soon as she had left them the youngsters came out and began playing again. The mother returned and again pushed them into their safe retreat, appearing much excited at my presence. This was continued for a number of times, until I tired of watching the performance. Near Vallecito, June 5, 1907, the young were half or two-thirds grown, and two weeks later a great many young of about the same age were seen north of Dolores.

These ground squirrels go into winter quarters during October—at the higher elevations early in the month.[1] At McCoy, on Grand River, I noted only one, October 9, 1906, and on my return through Middle Park and over Berthoud Pass, from October 12 to 18, saw none. In 1907 the latest records were: One at St. Elmo (10,500), October 10; one at Sapinero (7,300 feet), October 16; and one east of Lake San Cristobal, San Juan Mountains (9,500 feet), October 18.

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[1] Warren writes me that he shot one at Colorado Springs Nov. 11, 1909, which is an unusually late record.

Streator found the species had hibernated at Gold Hill, October 27, 1894; while Warren states that it had disappeared for the winter at Crested Butte before October 8, 1905.[1] They are said to come out in spring before the snow is gone. On this point Warren observes: "While it disappears, in the Elk Mountains at least, with the first snowstorms in early October, it comes out in the spring before the snow is gone. I have known it to tunnel through 3 feet of snow to get to the surface. A specimen taken early in April under such circumstances was very fat."[2]

Callospermophilus lateralis wortmani (Allen). Wortman Ground Squirrel.

This pale form, described from Kinney ranch, Sweetwater County, Wyoming, inhabits the rough bad-land region which borders the lower Snake and Bear Rivers in western Routt County, and, so far as known, is restricted to this low arid Upper Sonoran country and the adjoining desert areas of Wyoming. (See fig. 5.) Specimens from the plateaus and mountains to the east, south, and west, in the Transition zone, are referable to *C. lateralis*; but, as noted under that species, specimens from near Rangely, in the Upper Sonoran area of the White River Valley, although referred to *C. lateralis*, are paler and approach the present form.

A specimen of *C. wortmani* from the northern edge of Routt County, 20 miles southwest of Baggs Crossing, Wyoming, August 26, 1906, was taken in a trap set for wood rats among the scattering junipers which clothed the steep southern face of a rocky bluff on the north side of Snake River. This was the only one seen on my journey down the Snake River Valley in 1906, and the animals appeared to be rare. Another very pale individual, which appeared to be this form, was seen a few days later, however, among the bluffs on the north side of Bear River, near the mouth of Sand Creek, a few miles below Maybell. Near Lily, at the confluence of the Snake and Bear Rivers, this squirrel was said to be abundant. Several specimens from the Snake River bluffs, 7 miles north of Lily, collected by Warren in the summer of 1907 and sent to the Biological Survey for identification, are clearly referable to *wortmani*. Warren says the animals were tolerably common at this point, but I saw none while encamped at the same place the previous year.

Ammospermophilus leucurus cinnamomeus (Merriam). Antelope Squirrel.

The antelope squirrel is found in the warm desert areas of western and southwestern Colorado below 6,000 feet, chiefly in the valleys of the streams tributary to the Colorado and Green Rivers. There are specimens at hand from White River, 20 miles east of Rangely; Rangely; Fruita; Grand Junction; Hotchkiss; Coventry, 6,400 feet; and Ashbaugh's ranch, near McElmo. The northward dispersion is limited by the Yampa Plateau, between White and Bear Rivers. (See fig. 6.)

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[1] Mammals of Colorado, p. 241, 1906.

[2] Ibid, pp. 240-241, 1906.

In 1906 antelope squirrels were first met with in the White River Valley at the ford east of Angora, and from this point to the Utah boundary they were common among rock ledges along the river. In crossing the country between White and Grand Rivers we saw them until we were 10 miles southwest of Rangely, and not again until we reached Carbonera, at the southern base of the Book Cliffs. On the desert between Carbonera and Mack, and thence up the Grand River Valley to Palisade, the antelope squirrel is an abundant and characteristic mammal. It was not noted at any point in the White and Grand Valleys above 5,500 feet.

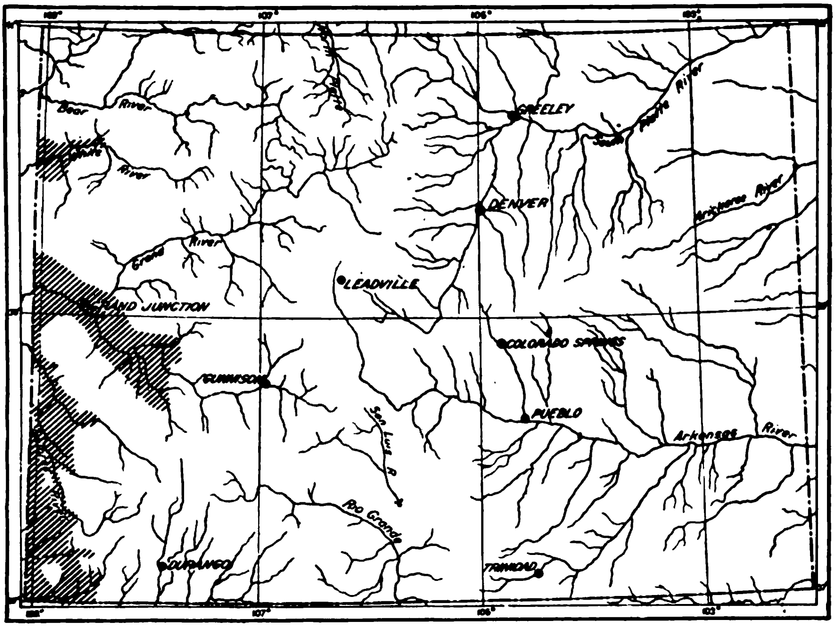

FIG. 6.—Distribution in Colorado of antelope squirrel (*Ammospermophilus leucurus cinnamomeus*).

East of the Uncompahgre Plateau the species ranges over a considerable area in the Gunnison and Uncompahgre Valleys. Mr. C. H. Smith, of Coventry, states that he has seen several at the eastern base of the plateau, southwest of Montrose. In the valley of the North Fork of Gunnison River it occurs east to Hotchkiss and probably to Paonia. In August, 1907, I found these squirrels tolerably common on the open rocky slopes north of the river at Hotchkiss, but did not see any near Crawford, at the base of the West

Elk Mountains. A skin in the National Museum, collected by Capt. James Stevenson September 18, 1873, labeled "Elk Mts.," probably came from some point at their western base.

The antelope squirrel is rather generally distributed in the warm valleys of southwestern Colorado. In Montezuma County it was not found at Mancos, but a single individual was seen on an *Atriplex* flat at the north base of Mesa Verde, a little west of Point Lookout, which appears to be the eastern limit. It is abundant along McElmo Creek, both among the rocky ledges in the canyon and on the lower bordering mesas. In the region of the lower San Miguel and Dolores Rivers the species is restricted to the hottest valleys and slopes, and was noted as follows: Naturita west to Dry Creek; Salt Canyon, outlet of Sinbad Valley; canyon of Dolores River, Salt Canyon to mouth of West Creek; and West Creek Valley to 4 miles above mouth. It does not extend through the Unaweep Canyon to connect with its range in the Gunnison Valley. Mr. William Boren, of Norwood, says antelope squirrels are common in Dry Creek Basin in Gypsum Valley, and on lower Disappointment Creek in western San Miguel County. The above localities indicate a general distribution below 6,000 feet.

Antelope squirrels frequent sandy arroyos and are striking objects as they frisk about in the morning sunshine with the pure white under surface of the upraised tail showing prominently. They are easily alarmed and retreat precipitately to the burrows, which are usually in the sandy bank of a dry desert wash or beneath sage or *Atriplex* bushes. In a few moments the animal may be watching the intruder from the mouth of a burrow or from behind a pile of rocks, but it disappears at the slightest noise or movement. At Fruita, Mesa County, several were living in the cemetery, and one or two burrows were found beside gravestones. None of the squirrels uttered a sound while under my observation, but one which J. Alden Loring heard near Grand Junction had a note described as "loud, shrill, and rattling, and gradually dying out like a policeman's whistle." Mr. Loring states that the antelope squirrel has from four to six young in a litter. Mr. George J. Ashbaugh and other ranchmen between Moqui and McElmo, Montezuma County, state that antelope squirrels do much damage in the spring by digging up newly planted corn. During my stay at Mr. Ashbaugh's ranch, June 18–23, 1907, the young were about two-thirds grown, and proved a nuisance by getting into traps placed at the mouths of *Perodipus* burrows on the small sandy flats at the base of the rocky canyon walls. The species is more or less active in winter, as Mr. C. H. Smith, of Coventry, has taken it in January.

Citellus variegatus grammurus (Say). Rock Squirrel.

Sciurus grammurus Say, in Long's Exped. Rocky Mts., II, p. 72, 1823. Type from Purgatory River, near mouth of Chacuaco Creek, Las Animas County, Colorado.

The large gray rock squirrel is common among the rock ledges of the eastern foothills, and also throughout the warm valleys of southern and southwestern Colorado north to the southern base of the Book Cliffs mainly in the Upper Sonoran zone. East of the mountains it is not known to extend north to the Wyoming line, but is found in the foothills west of Fort Collins. Along the eastern slope of the mountains it occurs regularly in open, rocky situations up to 7,000 feet, and toward the south is occasionally found to 8,000 feet. In the Grand River Valley the upper limit appears to be at 6,500 feet, a little below the upper edge of the juniper and pinyon belt. In some of the southwestern valleys, however, it ranges considerably higher, and on the southwestern slopes of the Uncompahgre Plateau extends well into the yellow pine belt wherever suitable rocky ledges occur. (See fig. 7.)

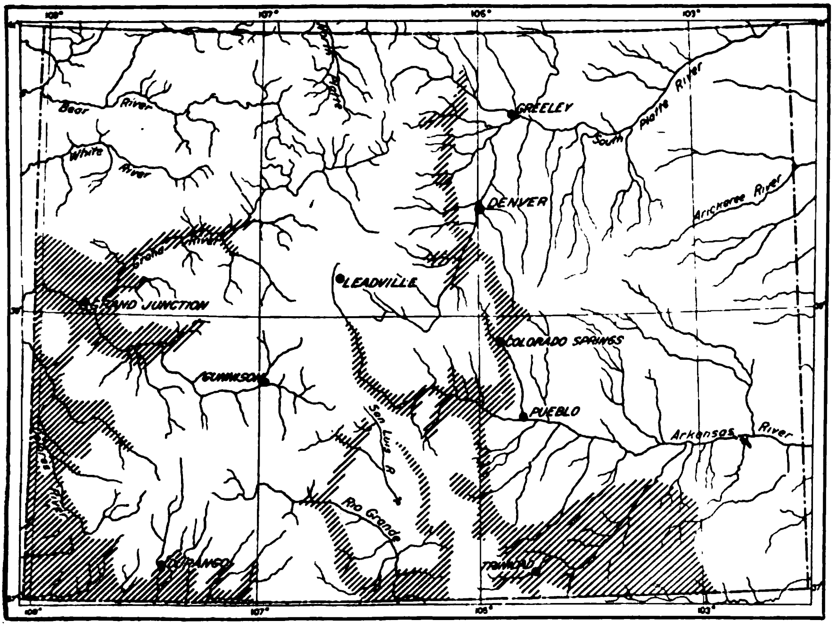

FIG. 7.—Distribution in Colorado of rock squirrel (*Citellus variegatus grammurus*).

The Biological Survey has specimens of *grammurus* from Higbee, Otero County, which are practically topotypes. Specimens from both eastern and western slopes are fairly typical, those from western Colorado not differing sufficiently to be referred to *C. v. utah*, described by Dr. Merriam from Ogden, Utah. Rock squirrels which I saw in the Grand River Canyon above Glenwood Springs in October, 1906, appeared quite reddish on the back, however, in this respect suggesting the Utah form.

Rock squirrels nearly always live in rocky situations, the ledges and bowlder-strewn sides of canyons, the bare rocky slopes along the base of the foothills, and the rim rock of outlying mesas and buttes being especially frequented. In the pinyon country near Bayfield, La Plata County, their burrows were often found along the margins of fields in a nearly level country. As a rule, however, the burrows are located beneath bowlders at the base of a rocky canyon rim or in rock slides. Rock squirrels are quite shy and wary, and when one is surprised in the bottom of a canyon, as is often the case, it invariably runs up the slope and takes refuge among the rocks above. If the observer remains perfectly quiet, he may at length detect the animal peering silently over the top of a large bowlder, but it generally vanishes at the slightest noise or motion. I watched one of these squirrels dusting itself near Bayfield. Apparently it was unaware of my presence and at intervals would run to a dusty spot in a path, throw the dust up with its fore feet, turn on its back, and wriggle and squirm along the ground in the greatest enjoyment. This performance was repeated a number of times, when suddenly the little fellow spied me and raced off through the brush.

The food of rock squirrels consists chiefly of pinyon nuts, acorns, and juniper berries, and consequently over much of their range the animals do little damage. In some sections, however, they are reputed to show a fondness for young chickens. Rock squirrels are abundant in the McElmo Valley, Montezuma County. Mr. George J. Ashbaugh states that they destroy many apricots on the trees for the sake of the seeds, of which they are especially fond;[1] they eat holes in cantaloupes and watermelons on the vines in search of the seeds, which they carry into the rocks to be eaten at leisure; and they also dig up and eat much newly planted corn.

While at Ashbaugh's ranch in June, 1907, I often heard the sharp alarm notes of rock squirrels in the orchard back of the house. Near Coventry in July they were feeding extensively upon pinyon nuts. In Grand Valley, near Glenwood Springs, in October, 1906, numbers were seen in the tops of large pinyons busily feasting upon the nuts, and so common is this habit in that section that the animals are locally known as gray tree squirrels.

There are few data at hand on the breeding of *C. grammurus*. An old female collected by Loring at Lyons, May 28, 1893, was heavy with three large fetuses; while the young squirrels were about half grown at Ashbaugh's ranch, June 19, 1907.

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[1] Warren (The Mammals of Colorado, p. 163, 1910) states that a rock squirrel which was killed at Ashbaugh's ranch in the fruit season had 50 or more apricot pits in its pouches.

Citellus elegans (Kennicott). Wyoming Ground Squirrel.

This large gray ground squirrel is common in the mountain parks and on the sage plains of the northwestern part of the State. It does not appear to range south of the valley of Grand River, and it occurs east of the main ranges only in the Laramie River country. (See fig. 8.) It is abundant in Middle and North Parks, ranging across the Rabbit Ear Mountains at Arapahoe Pass (9,000 feet), and doubtless at other points where there is sufficient open country. In crossing the Medicine Bow Mountains west of Glendevey I did not meet with this squirrel, and assume that its range extends from North Park around the north end of the Medicine Bows into the Laramie Valley. A specimen in the National Museum from Cameron Pass, at 10,000 feet, was probably taken on the North Park side. The species was observed in the small parks along the heads of watercourses on the high forested divide east of the Laramie River as high as 10,300 feet, and extends east to Log Cabin and Fish Creek,[1] Larimer County, which points are near its eastern limits. In Routt County it is found everywhere except in the higher Elk Head and Williams River Mountains, the Escalante Hills, the Yampa and O-wi-yu-kuts Plateaus, and the higher western slope of the Park Range. Several of these ground squirrels were observed about 10 miles northwest of Hahns

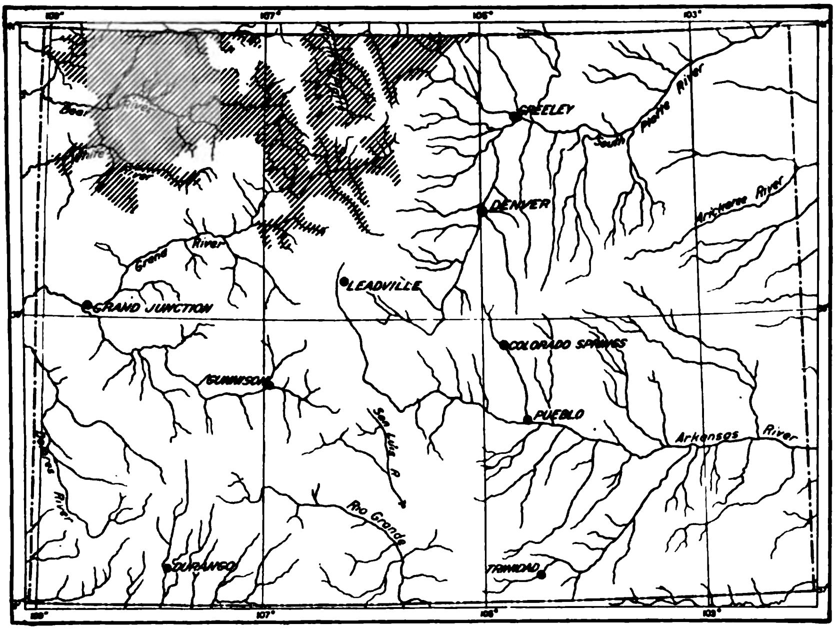

FIG. 8.—Distribution in Colorado of Wyoming ground squirrel (*Citellus elegans*).

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[1] Bailey, Spermophiles of Mississippi Valley, Bull. No. 4, Biological Survey, p. 60, 1893.

Peak, which appears to be near its eastern limit in the Snake River country. It ranges to the headwaters of Bear River, in Egeria Park, thence south to McCoy, on Grand River, and south across the Piney Divide to Wolcott. The heavily forested Gore Range, east of Egeria Park, apparently proves a barrier, although the species is common in the parks on its western slope 8 miles east of Toponas. In the Eagle River Valley I found *C. elegans* tolerably common from Gypsum to Wolcott, and Warren reports it present to a point 3 miles east of Minturn, while in the valley of White River it occurs from Buford west as far as Rangely. From Meeker the range is north across the Danforth Hills to Axial Basin, south in the valley of the Piceance to Rio Blanco,[1] and from Angora north to Lily, on Bear River.

The sage flats in Middle and North Parks are densely populated with these ground squirrels, and ranchmen consider them very injurious to the cattle range and to small grain. Judging from my own observations the damage inflicted is by no means slight, and when the large territory inhabited by them is considered, it must be very considerable. During July I often saw numbers in the rye fields eating the green stalks, and not a vestige of grass remained near their burrows. Ranchmen in the Snake River Valley between Honnold and Slater claim that this species destroys fully a third of the rye crop, pulling down the stalks to get at the heads, and the appearance of the small fields in August, 1906, fully sustained their statement. In the summer of 1904 a 5-acre field of oats on Little Bear Creek, a tributary of Fortification Creek, is said to have been utterly ruined by ground squirrels. In North Park I often saw them in the hay meadows, whither they resort in the early morning, busily engaged in pulling down and eating the tall grass stems.

This species hibernates very early in the autumn. In 1905 none were observed at Lay August 3, and Mr. A. G. Wallahan informed me that they retired to winter quarters about the middle of July, although in the lower Snake River country they usually remain active until about August 1. August 17, 1906, a few were out near Honnold, but the majority were already in hibernation. An immature specimen was taken in a trap set in the underground tunnel of a pocket gopher near Baggs Crossing August 24, but none were noted above ground. A very few were seen near Meeker August 12, 1905. At Sulphur Springs, Middle Park, Warren found these squirrels running about in fresh snow on stormy days in April, and they probably come out of hibernation somewhat earlier at the lower elevations. I noted a great many burrows which had been opened by badgers, which appear to feed extensively upon this species—a fact well worth noting by farmers and stockmen.

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[1] Specimen in U. S. National Museum.

Citellus tridecemlineatus pallidus (Allen). Pale Striped Ground Squirrel.

This is the common striped ground squirrel of the plains, but it is found also in some of the mountain parks on the eastern slope of the mountains at an elevation of over 9,000 feet. It occurs also sparingly in North Park. It is replaced on the sage plains and in the mountain parks west of the Continental Divide, and also in the San Luis Valley, by another form of the same group—the little *C. t. parvus.* (See fig. 9.) Specimens from Loveland, Sterling, Pawnee Buttes, Tuttle, Eureka Hill (Cheyenne County), Las Animas, and other localities indicate a general distribution over the plains of eastern Colorado.

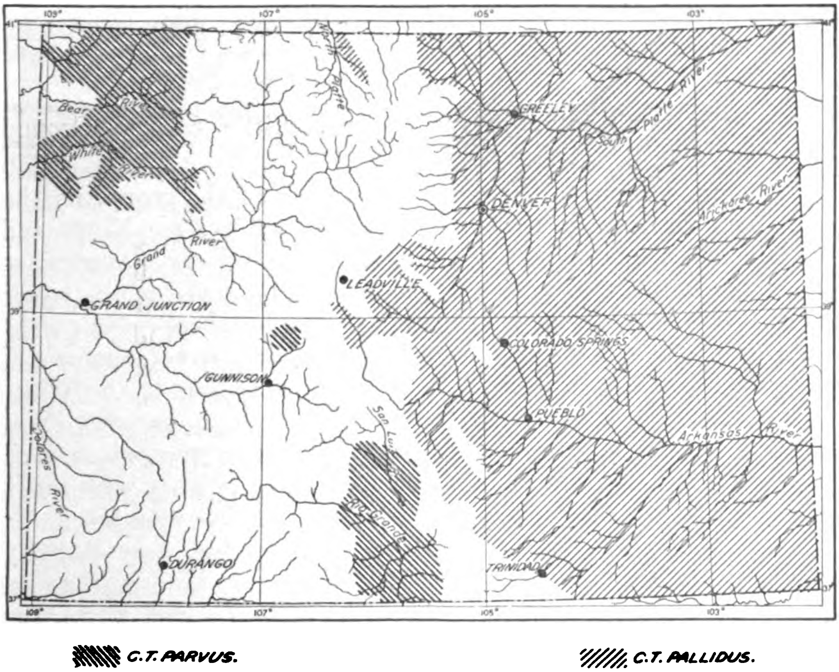

FIG. 9.—Distribution in Colorado of striped ground squirrels (*Citellus t. parvus* and *C. t. pallidus*).

At Golden the pale striped ground squirrel is common both on the plains and in the parks of the foothills at 7,300 feet. One was found dead in the trail near Elkhorn, in the foothills of Larimer County, at 7,500 feet. In North Park small numbers were occupying an isolated strip of sandy country east of Canadian Creek, at the west base of the Medicine Bow Range. *C. pallidus* has doubtless reached this region from the north, as the Medicine Bow Range is an effective barrier on the east. It was not observed on the sage plains of central and western North Park. It is common in the Wet Mountain and Huerfano Valleys, and near La Veta in the Cucharas Valley; and on August 23, 1907, I found it abundant and active on the high grassy plains of South Park near Como, at an elevation of 9,800 feet. It is reported also from the upper Arkansas Valley near Buena Vista, but I did not find any at Salida. The National Museum has a specimen from Twin Lakes. The species probably reaches the upper Arkansas Valley from South Park through some of the open mountain passes.

Over most of its range this ground squirrel is injurious to truck gardens and grain fields. Its worst habit is that of digging up newly planted corn and eating the kernels. Near Valmont, Boulder County, in June, 1905, it was reported very injurious. Because of its depredations several farmers were obliged to plant their sweet corn a second time. In this section it was living in burrows along the grassy margins of gardens and cultivated fields.

Citellus tridecemlineatus parvus (Allen). Little Striped Ground Squirrel.

This ground squirrel, the smallest member of the group, has its center of abundance in the semidesert areas of western Routt and Rio Blanco Counties. (See fig. 9.) This region was traversed so late in the summer, in both 1905 and 1906, that most of the squirrels were already hibernating; therefore their numbers could not be ascertained. The few observed were living in deserted burrows of white-tailed prairie dogs, with the exception of three in the White River Valley, which were occupying small burrows apparently excavated by themselves. The squirrels collected were sluggish in their movements and extremely fat, which indicated that they were ready for hibernation. They were usually sitting at the mouths of the burrows enjoying the warm autumn sunshine, but near Rangely one was seen in the top of a *Sarcobatus* bush. At Mud Springs, on the White River Plateau at 9,000 feet, *C. parvus* was occupying deserted burrows of *Thomomys fossor*. Two adults and two young were observed in a park at this point August 18, 1905. This squirrel is reported as common in Lily Park, at the confluence of the Snake and Bear Rivers; in Browns Park, near the Utah boundary; and on the Iron Springs Divide, between the Snake and Bear Rivers. In the Snake River Valley it is found as far east as the mouth of Four-mile Creek, where one was seen August 22, 1906. Warren states that he saw it at Big Beaver Creek, Rio Blanco County, in 1907.[1] During my investigations six specimens were collected, as follows: Axial Basin, August 8, 1905; Mud Springs, White River Plateau, August 18, 1905; Escalante (7 miles west), August 31, 1906; and Rangely, September 13 and 17, 1906.

This little ground squirrel is the form occurring over most, if not all, of the San Luis Valley. Loring found it not uncommon at

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[1] Further Notes on the Mammals of Colorado, p. 71, 1908.

Fort Garland in July, 1892, and collected three specimens, while Mr. J. H. Gaut secured two at Antonito, Conejos County, August 30 and 31, 1904. Bailey has observed this ground squirrel at La Jara, and it was reported to me as abundant at the Medano Springs ranch, near the San Luis Lakes, in 1907. While in the San Luis Valley in 1909 Warren found it at Mosca, San Luis Lakes, and at Moffat.

Nothing is known of the distribution of *C. parvus* in the region between the White River Plateau and the San Luis Valley aside from a specimen in the U. S. National Museum labeled "Elk Mts.," collected by Capt. Stevenson September 6, 1873.

Citellus obsoletus (Kennicott). Kennicott Ground Squirrel.

This is the small grayish ground squirrel inhabiting the sandy areas on the plains north of the Arkansas Divide. It does not appear to be present on the higher plains, being found principally in the valleys of the Platte and Republican Rivers and their tributaries. The western limits of range have not been ascertained. A specimen in the Colorado Historical and Natural History Society collection was taken at Sand Creek, near Denver, and the Biological Survey has the species from Greeley. Specimens from Hugo, Tuttle, Wray, Sterling, Avalo, and Greeley are referable to *C. obsoletus*, although there is considerable variation. Specimens from Wray and Tuttle have the coloration of *obsoletus*, but in size approach *major*. The Sterling series agrees best with specimens of *obsoletus* from Cherry County, Nebr. (assumed to be typical), in small size and in coloration, most of the specimens having the characteristic coal-black edgings of the indistinct spots on posterior part of dorsum.

Like most other forms of spotted ground squirrels, *C. obsoletus* is largely restricted to sandy country. In starting northwest across the plains from Cheyenne Wells in 1909, I first saw the species on the level plain a few miles northwest of that point May 10. No others were found until I reached the South Fork of Republican River, where an adult male was shot 5 miles east of Tuttle May 18. The following day another was collected on the hard soil divide 2 miles south of Wray, and one was noted in the sand 2 miles east of the same point. Mr. W. E. Wolfe, of Wray, informed me that in the valley east of the town these squirrels are more numerous than the striped ground squirrels. May 24 a spotted ground squirrel was seen in the sand hills midway between Wray and Yuma. I saw none in crossing the hard soil watershed between Yuma and Sterling. The species was encountered 6 miles southeast of Sterling May 28, one being trapped in a gravelly arroyo just below the bluffs, and others were taken in the sand along the east side of the Platte at Sterling a day or so later. The only one found northwest of Sterling was dug out of its burrow on a hard soil flat along Horsetail Creek, 13 miles east of Avalo, June 3. Prof. Lantz found these ground squirrels common south of the Big Sandy near Hugo. A burrow which he dug out in sandy soil was 12 feet in length, but at no place more than 18 inches below the surface. This burrow had three entrances and terminated in a small round chamber which contained a slight nest of grass, in which, instead of a squirrel, a large bull snake was coiled.

Citellus spilosoma major (Merriam). Large Spotted Ground Squirrel.

Spotted ground squirrels from the Arkansas Valley and southward, though not typical, are referred to this form. Specimens from Las Animas and La Junta (18 miles south) in the Biological Survey collection agree in size with typical *major* from Albuquerque, New Mexico, but are grayer. Others collected by Warren at Lamar and at Monon, Baca County, are best referred to this form. These are said to be the common ground squirrels in the Arkansas Valley at Pueblo.[1] Spotted ground squirrels from the Arkansas Divide and northward are nearest *obsoletus*, indicating that the two forms may intergrade in southern Colorado. Prof. D. E. Lantz, who collected specimens south of La Junta, thinks this form comes out of hibernation about April 20.

Cynomys ludovicianus (Ord). Prairie Dog.

This is the large brown prairie dog of the eastern plains of Colorado. There is probably not a county east of the foothills in which it is not present in considerable numbers, and colonies are found in some of the broader foothill valleys to an elevation of 6,000 feet. The western limit of range may be roughly indicated by Livermore, Larimer County; Lyons; Boulder; Rockvale, Fremont County;[2] Badito, Huerfano County; and Trinidad.

At several points in southern Colorado the range of this species almost meets that of the smaller *C. gunnisoni*, but usually the two species are separated by a vertical distance of from 1,000 to 2,000 feet—*ludovicianus* occupying the valleys and the flat tops of the lowest mesas, while *gunnisoni* lives in the parks of the highest foothills and in the mountains. Near Badito colonies of both species are found within a mile or so of each other—*ludovicianus* occupying the flat along Huerfano River, and *gunnisoni* the open parks among the pinyons on the first benches south of the river and only a few hundred feet above it. At Gardner, 12 miles above Badito, *gunnisoni* is found in the Huerfano Valley.

Prairie dogs are especially abundant along the Santa Fe Railroad between Trinidad and La Junta, and in Baca County in the extreme southeast corner of the State. In 1909 I found them common on the eastern end of the Arkansas Divide near Cheyenne Wells, and again from a point 15 miles northwest of Sterling west to Grover. Their numbers are decreasing in Yuma County and elsewhere, owing to rapid settlement. Numerous grass-grown mounds between Yuma and Sterling indicate that formerly the animals were abundant, but in 1909 I saw very few inhabited colonies in this section. In the thinly settled grazing country dog towns often cover large areas of excellent cattle range and are thus a source of loss to stockmen.

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[1] Warren, Mammals of Colorado, p. 242, 1906.

[2] Field Col. Mus. Pub. 115, Zool. ser., VIII, p. 181, 1907.

In 1892 Dr. A. K. Fisher found this species abundant at Trinidad in open places among the pinyons on the table mountains, and reports that at Las Animas nine prairie dogs were drowned out of a single burrow. In 1905 Prof. Lantz reported a colony at Byers in which albinos are common, stating that "a dozen pure white specimens can sometimes be seen at a time." Near Higbee, Otero County, Prof. Lantz reports that all the females had apparently given birth to young before April 12, 1910. In six instances the number of young was six; in two instances it was four.

Cynomys gunnisoni (Baird). Gunnison Prairie Dog.

Spermophilus gunnisoni Baird, Proc. Acad. Nat. Sci. Phila., VII, p. 334, 1855. Type from Cochetopa Pass, Saguache County, Colorado.

The type of *Cynomys gunnisoni* was collected by F. Kreuzfeldt on Capt. E. G. Beckwith's expedition in 1853. The species is considerably smaller than *C. ludovicianus*, with very short ears and tail, the latter bordered and tipped with white. Like *C. leucurus* of northwestern Colorado, it does not seem to be of marked gregarious habits, the burrows being scattered here and there over valleys, mesas, and even steep slopes. It is more of a mountain animal than either of the above species, but is equally at home in the Upper Sonoran, Transition, and even lower Canadian zones.

This is the prairie dog so abundant in South Park, in parts of the upper Arkansas, San Luis, and Rio Grande Valleys, and in the open country and valleys south and west of the San Juan and La Plata Mountains and the Uncompahgre Plateau. It crosses the Cochetopa Pass into the Gunnison country and ranges as far west as the Black Mesa. The northern and western limits are indicated by localities as follows: Como (South Park), Twin Lakes, Leadville, near Crested Butte,[1] Black Mesa, Cerro Ridge, and the Uncompahgre Plateau. The ranges of *gunnisoni* and *leucurus* do not seem to meet at any point, although separated by only a very narrow strip of country in the Cimarron region. *C. gunnisoni* is known to inhabit the lower western parts of Montezuma, Dolores, San Miguel, and Montrose Counties, and doubtless extends westward some distance into eastern Utah, possibly in that region also approaching the range of *C. leucurus*.

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[1] Further Notes on the Mammals of Colorado, p. 71, 1908.

Prairie dogs are reported abundant on the extensive sage flats and deserts south of the La Sal Mountains, but the species is not known.

In crossing the Continental Divide between Lake City and Creede, *C. gunnisoni* was not noted south of Lake City, but was again seen on the flats just below Lake Santa Maria, at 9,400 feet, and it may occur still farther up the Rio Grande Valley. The range is continuous across the Poncha Pass, between the San Luis and Arkansas Valleys, and also across Trout Creek Pass, between the Arkansas Valley and South Park. To the east this species is common in the small mountain parks near Divide, Teller County, at 9,500 feet, and extends down the Fountain Creek Canyon to Cascade. It follows the Arkansas River down to Texas Creek and thence extends south across the Wet Mountain Valley to the Huerfano, and down this valley to Badito. It occupies the divide between the Huerfano and Cucharas Rivers, and from near La Veta apparently follows southeast around the Spanish Peaks, as it is again met with on the parks and plateaus of the Trinidad region. In open sections like South Park, it reaches its upper limit at between 9,500 and 10,000 feet, but the vertical range is governed entirely by the character of the country. Thus on the southern slopes of the San Juan Mountains in Archuleta and La Plata Counties, where there is an extensive area of yellow pine forest between 7,000 and 8,500 feet, prairie dogs are not found so high, along the Rio Pinos occurring only as far up as Vallecito, at about 8,000 feet.

As the higher part of its range is a region of very limited agriculture and supports an abundance of wild grasses, this species can not there be considered very injurious, but in some of the low irrigated valleys of the southwestern counties it is very destructive to grain and alfalfa fields. On the South Park plains, just east of Como, in August, 1907, the heads of prairie dogs could be seen sticking out of the tall grass in all directions, but grass was so abundant that they were making no visible impression upon it. The greatest damage caused by prairie dogs was reported from Coventry, the McElmo Valley, and near Bayfield. At the last two localities the ranchmen successfully drown them out of all the low ground which can be reached with ditch water; but on the neighboring benches and mesas, and even on the largest dry knolls in the fields, the prairie dogs more than hold their own, as comparatively few ranchmen take the trouble to poison those left on high ground. Several ranchmen at Bayfield have for several years kept their land clear of prairie dogs by the use of carbon bisulphide or wheat soaked in strychnine, but a lack of cooperation permits the animals to maintain their present abundance. In a single pasture in the Rio Pinos Valley 181 prairie dogs are said to have been drowned out and killed in a single day. Old residents at Bayfield state that 15 years ago the animals were unknown in the valley, but that they have gradually worked northward with the cultivation of the land. According to Mr. C. G. Bates, of Bayfield, a peculiar disease killed the larger part of the prairie dogs on Florida River some years ago. The affection is said to have caused excessive weakness, and in its later stages loss of hair.

This species appears to hibernate throughout the winter. It was out in abundance at Divide, and also on the South Park plains between Howbert and Hartsel, October 5, 1907, and all of the animals appeared fat, sleek, and well furred. At Sapinero two were seen out of their burrows October 16, but none thereafter, although I was in good prairie-dog country until mid-November.

Cynomys leucurus Merriam. White-tailed Prairie Dog.

This handsome species replaces *C. ludovicianus* and *gunnisoni* on the sage plains of northwestern Colorado, where it occupies much of the open country west of the Park and Gore Ranges and north of the lower Gunnison Valley. It occurs also in North Park, but I did not find it in Laramie Valley, east of the Medicine Bow Range, nor does it range across the Rabbit Ear Mountains into Middle Park and Blue River Valley. In Snake River Valley it is found east to Honnold, and in White River Valley it is common as far up as the mouth of South Fork. Prairie dogs occur throughout the Bear River region, and follow this stream to its headwaters in Egeria Park; thence, sparingly, south across the divide to McCoy on Grand River, and again across Piney Divide to Wolcott, on Eagle River, and west in the Grand Valley to Gypsum. They do not extend through the Grand Canyon above Glenwood, nor do they pass around it, and they are absent from the Grand Valley between Glenwood and Grand Junction. On the desert areas between Grand Junction and the Utah boundary, prairie dogs are common, doubtless coming in from the west, where the range is probably continuous around the western end of the Book Cliffs in Utah. They range from the Axial Basin south across the lowest passes of the Danforth Hills to the White River Valley at Meeker, but apparently do not cross the White River Plateau or its western extension, the Book Plateau, at any point in the State.

Instead of extending northeast from Grand Junction in the narrow Grand Valley, *C. leucurus* ranges to the southeast in the broad Gunnison and Uncompahgre Valleys, and occurs over a wide area between the Grand Mesa and Uncompahgre Plateau. In the Uncompahgre Valley it was noted south to a point on Dallas Creek, a few miles west of Ridgway. East of Montrose it was abundant along the railroad at Cedar Creek, and a few were seen almost to the summit of Cerro Ridge, between Cedar Creek and Cimarron. None were observed at Cimarron, and the divide between the Cimarron and

Uncompahgre Rivers appears to mark the eastern limit of range in this region. The species extends east along the North Fork of the Gunnison to Hotchkiss and Paonia, and was abundant at the west base of the West Elk Mountains, between Hotchkiss and Crawford. The majority observed in this section were on the dry adobe flats, where the only vegetation worthy of mention was the prostrate, scrubby, desert-growing *Atriplex nuttalli* and a sparse growth of *Dondia* (probably *D. moquini*) in damp alkaline spots.

C. leucurus is not unlike *gunnisoni* in size and general coloration, but may be readily distinguished from the latter by its white tail and by the broad dusky patch which covers the eye and extends down over the cheek. It is not extensively colonial, the burrows being scattered here and there over the sage plains. The burrows are apparently occupied for many years, and the ejected earth accumulates into very large mounds, often as much as 3 feet in height and 8 or 10 feet in diameter. These prairie dogs are not very shy and often sit at the mouth of the burrow until approached within a rod. The usual note is a peculiar querulous cry, very unlike the short, sharp bark of *ludovicianus*. Chattering alarm notes also are occasionally heard as one walks through a colony.

Wherever white-tailed prairie dogs live in the neighborhood of cultivated ground they are very injurious to green crops. Loring states that in the vicinity of Grand Junction the burrows are usually in the dry banks of irrigating ditches, and the prairie dogs inflict considerable damage on the adjacent truck farms by eating cabbages, cantaloupes, and other crops. While eating, they sit erect on their hind legs, but if disturbed run to the burrows, carrying the food in their mouths. They destroy considerable areas of range grasses and feed extensively in alfalfa fields and hay meadows in the river valleys throughout their range.

Marmota engelhardti Allen. Engelhardt Woodchuck; Marmot.

The Colorado marmots are tentatively referred to this species, which was described from Beaver Mountains, Utah. The scanty material at hand is insufficient for accurate comparison, and definite conclusions are impossible in view of the present condition of the group.

The marmot is one of the most characteristic mammals of the mountains, and occurs from 6,000 feet in the foothills to the rocky summits of the highest peaks, at over 14,000 feet. It has, therefore, a vertical range of about 8,000 feet. Marmots are much more abundant above than below 8,000 feet, and are especially numerous in the slide rock near timberline. They are reported present on the summit of Grays Peak, at an elevation of 14,341 feet, and have been observed also on the summit of Longs Peak, 100 feet lower. The clear, shrill whistle of the marmot is one of the few sounds that break the silence of the high altitudes, and the large reddish-brown animals may often be seen sunning themselves on the warm, flat surfaces of rocks during the middle of the day. In the Hahns Peak region marmots were abundant, and were usually seen around abandoned prospect holes and mining shafts, while at Arkins, Larimer County, one was living in an old sandstone quarry. On the Bear River meadows east of Hayden, Routt County, in August, 1905, I saw a marmot run into its burrow beneath a pile of brush, while a week later four were observed feeding on grass in a meadow along Good Spring Creek, on the north slope of the Danforth Hills. I have found marmots more or less common at Coulter; Mount Whiteley; McIntyre Creek, Medicine Bow Mountains; Elk Head Mountains; Mount Kelso; near Boulder; Sapinero; and Georgetown. They are reported common in the following localities: St. Elmo; Lone Cone; Pagosa Springs; La Plata Mountains, northeast of Mancos; San Juan Mountains, north of Vallecito; Silverton; Cochetopa Pass; Estes Park; and Longs Peak.

In Park County, in 1871, Allen found the marmot abundant from the Platte Valley to above timberline, and states that black specimens occur frequently in that region.[1]

Epimys norvegicus (Erxleben). Norway Rat; Wharf Rat.

There is very little information available on the distribution in Colorado of this noxious species, which is usually known as barn rat or house rat. Doubtless by this time it has reached most of the larger towns at least, as Warren says it is found in Denver, Colorado Springs, Pueblo, and Greeley;[2] and in 1905 I was informed that it was common in the Boulder warehouses. Rats are uncommon away from towns, and I have met very few ranchmen whose buildings are infested with them. Mr. C. H. Smith, of Coventry, Montrose County, reports a very few on his ranch, so they are probably more or less common over the western part of the State, although Warren did not hear of them at Grand Junction. Near Valmont, Boulder County, I caught a large Norway rat in a trap set at a ground squirrel burrow in a prairie dog town, a quarter of a mile from the nearest farm.

Mus musculus Linnæus. House Mouse.

I have not seen the common house mouse in the higher mountains, and have no information regarding its presence above the Transition zone. It is tolerably common in cultivated districts on the plains, in towns, and around farm buildings, and even in fields and meadows, but is not such a pest as in the older settled States. House mice are by no means restricted to the vicinity of railroads, for I have found them in sparsely settled districts 40 or 50 miles from the nearest railroad. At Ashbaugh's ranch, near McElmo, Montezuma County, one was taken in a tule marsh along McElmo Creek, and I have elsewhere observed that marshes are much frequented by this species. A house mouse was killed in one of the buildings at Gaume's ranch, northwestern Baca County, a region where ranches are many miles apart. Another was caught in the barn at the Medano Springs ranch, near the San Luis Lakes. Prof. Lantz found them abundant near Higbee, in southeastern Otero County. White-footed mice of several species take the place of house mice over much of the timbered and canyon country, and in many places are associated with the latter about buildings and sheds.

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[1] Bull. Essex Inst., VI, p. 57, 1874.

[2] Mammals of Colorado, p. 244, 1906.

Onychomys leucogaster pallescens Merriam. Pale Grasshopper Mouse.

The large pale grasshopper mouse is generally distributed over the Upper Sonoran plains and deserts on both sides of the Continental Divide, except in the northwest corner of the State, where the smaller *O. brevicaudus* replaces it. (See fig. 10.) Specimens from the southwestern desert region and also from the San Luis Valley are larger and paler than those from the northeastern plains, where an approach to *O. leucogaster* is suggested by the darker color.

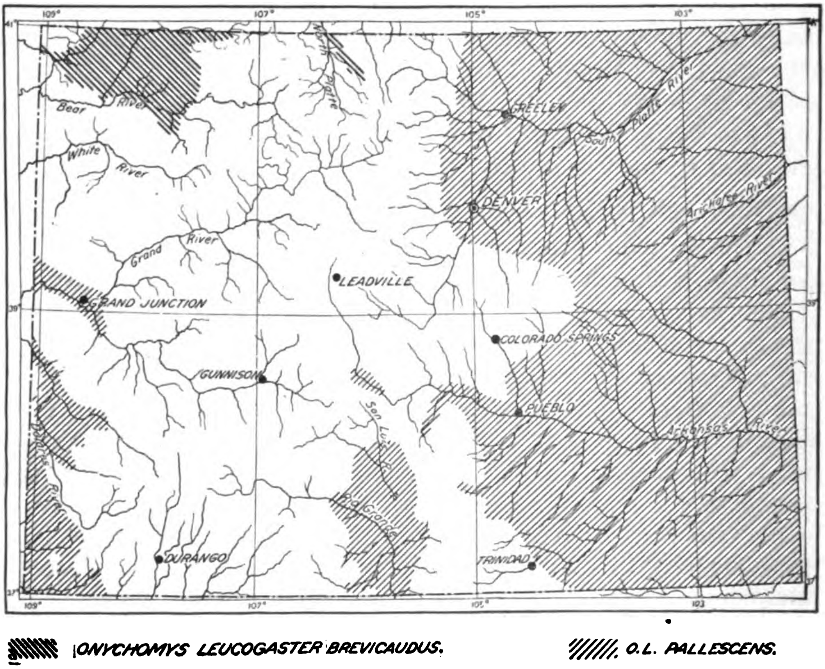

FIG. 10.—Distribution in Colorado of grasshopper mice (*Onychomys l. brevicaudus* and *O. l. pallescens*).

This species apparently occupies a considerable area in western Montezuma, Dolores, San Miguel, Montrose, and Mesa Counties, but its range is imperfectly worked out. The distribution in the lower

Grand River Valley appears to be limited, the only specimens thus far taken coming from Fruita, and the Uncompahgre Plateau must certainly separate the Grand Valley range from the more extensive area occupied farther south. The Book Cliffs limit its northward dispersion and separate it from *brevicaudus*. In the San Luis Valley it undoubtedly occurs throughout the Upper Sonoran zone. The grasshopper mice of the Upper Arkansas Valley above the Grand Canyon would appear to be separated from those of the eastern plains by the Royal Gorge, but nothing is known of the distribution in this section aside from the specimens taken on the sandy slopes along the east side of the Arkansas Valley just above Salida. Warren has taken *O. pallescens* in the Wet Mountain Valley. It may have reached this high mountain valley from either the Arkansas Valley on the north or the Huerfano Valley on the south.

Grasshopper mice are nocturnal. They especially frequent sandy areas, and are often taken in traps set at the burrows of kangaroo rats, ground squirrels, and pocket mice. Their carnivorous propensity is one of the chief obstacles the collector meets in trapping the rarer desert mice, and often after nights of trapping without success he is chagrined to find in one of his traps the partly devoured and mangled remains of a rare pocket mouse. Sometimes in regions where grasshopper mice are plentiful, a miscellaneous catch of other species will be almost ruined by them. Much of the food of grasshopper mice consists of soft-bodied insects, such as grasshoppers and crickets. The name scorpion mice, sometimes applied to these rodents, is due to a marked fondness for scorpions, which probably form part of their food in Colorado, particularly in the southwest. Vegetable food also is eaten. At the Medano Springs ranch, near the San Luis Lakes, these mice proved a nuisance by eating carrots, potatoes, and cabbages in a vegetable cellar.

Because of the nature of their food, grasshopper mice decompose much more rapidly than mice which feed chiefly on seeds and vegetable matter.

The pale grasshopper mouse is represented in the Biological Survey collection by a large series of specimens from Loveland, Pawnee Buttes, Sterling, Greeley, Golden, Hugo, Limon, Loco, Canon City, Salida, Burlington, Las Animas, La Junta (18 miles south), Gaume's ranch (Baca County), Antonito, Medano Springs ranch, and Conejos River, in eastern and southern Colorado; and others from Fruita, Coventry, and Naturita, in the southwestern part of the State. I have taken immature specimens at Arkins, in the foothills of Larimer County, and at Ashbaugh's ranch, near McElmo, Montezuma County. A skull in the Merriam collection is from Roggen, Weld County. Specimens from additional localities, Springfield and Monon (Baca County), Moffat, Hooper, San Luis Lakes, Crestone, and Westcliffe, are in the Warren collection.

Onychomys leucogaster brevicaudus Merriam. Idaho Grasshopper Mouse.

This small species apparently does not range south of Bear River, in northwestern Colorado. (See fig. 10.) On the sage plains of North Park it occurs as high as 8,500 feet in the upper part of the Transition zone, but in the region between Snake and Bear Rivers, in western Routt County, it inhabits a much lower altitude. It is usually met with in sandy strips of country, but at no point is it abundant, being always greatly outnumbered by white-footed mice. This species is represented by a series of eight specimens from Canadian Creek, east of Walden, North Park; Snake River, south of Sunny Peak, Routt County; and Bear River, south of Lay.

Allen records a specimen from Three Forks (forks of Snake River), in northeastern Routt County.[1] Warren mentions specimens taken by himself at Craig, and on Snake River 7 miles north of Lily.[2]

Peromyscus leucopus tornillo Mearns. Texas White-footed Mouse.

This form represents *P. leucopus* in the arid region from the Rio Grande at El Paso, Texas, north to the Arkansas Valley. An immature pair collected in the brushy bottom along the Arkansas River at Canon City by Loring, and specimens taken by Warren at Lamar, and in Baca County at Monon, Springfield, and Gaume's ranch, indicate the known distribution of this form within the State. Much work remains to be done in working out the distribution of this and many other small mammals on the eastern plains. Judging from its habits farther south, it should be found in the brushy stream bottoms of most of the region lying south of the Arkansas Valley and east of the foothills, particularly in the piles of drift and rubbish left after freshets. Regarding its habits in Baca County, Warren says: "The specimens taken in Baca County were mostly found among the sandstone bluffs along the water courses, although a few were taken about some ranch buildings." [3]

Peromyscus maniculatus nebrascensis (Mearns). Nebraska White-footed Mouse.

This is the common white-footed mouse of the Upper Sonoran plains region of both eastern and northwestern Colorado, as shown by series of specimens from a great many localities. It is found also in the sandy strip of country along the eastern side of San Luis Valley. Along the edge of the foothills and the higher western plateaus it grades into the dark reddish *P. rufinus* of the mountains. Like that form, it inhabits all conceivable situations, but it is normally more abundant, and sometimes becomes exceedingly numerous despite coyotes, hawks, and owls. Such was the case on the sage plains of western Routt and Rio Blanco Counties in 1906; also at the Medano Springs ranch, in the San Luis Valley, in October, 1907, where in a single night 38 were caught in 1 acre by 60 traps, and their excessive numbers all but prevented my securing topotypes of *Reithrodontomys montanus*. On several occasions two were taken in a small trap at one setting. In the Green River Valley near Ladore white-footed mice were often seen in the dusk darting about the bases of cottonwood trees. They were everywhere a great nuisance, gnawing harness, foraging in our provisions, and, above all, depleting our much-needed supply of oats. In the rocky juniper and pinyon country of western Colorado this race is found over considerable areas with two other forms of white-footed mice, *P. truei* and *auripectus*, but everywhere outnumbers them.

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[1] Bull. Am. Mus. Nat. Hist., VIII, p. 253, 1896.

[2] Further Notes on the Mammals of Colorado, p. 72, 1908.

[3] Mammals of Colorado, p. 245, 1906.

Peromyscus maniculatus luteus Osgood. Yellow White-footed Mouse.

Five specimens in the collection of the Colorado Agricultural College have been identified by W. H. Osgood as *P. m. luteus*. They were collected in Spring Canyon, 4 miles southwest of Fort Collins. Others taken by Warren at Wray, Yuma County, seem referable to this beautiful yellowish species. There are specimens from Haigler, Nebraska, just east of the Colorado line, in the Biological Survey collection. Future collecting will doubtless show that *luteus* is present over much of the sandy area of the northeastern counties.

Peromyscus maniculatus rufinus (Merriam). Tawny White-footed Mouse.

The wide range of this form in the Colorado mountains is shown by a large series of specimens. The center of abundance is in the boreal zones on the main ranges. In the foothills east of the front ranges, and on the slopes of the plateaus in northwestern Colorado, it shades off almost imperceptibly into the pale form *nebrascensis* of the Upper Sonoran plains and valleys. Specimens from Estes Park, Boulder, Gold Hill, and Nederland show a decided approach to *P. nebrascensis*. *P. m. rufinus* is almost omnipresent in the mountains and lives indiscriminately under logs and brush piles in the heavy forests, among rocks, in cabins along streams, in mountain bogs, and among the sagebrush in mountain parks. In the southwest it occurs at lower elevations and inhabits semidesert areas. In the sand hills at the west base of the Medicine Bow Range, in North Park, this mouse was abundant among the *Chrysothamnus* bushes.

These mice were very numerous in the sandy flats along the eastern side of the Arkansas Valley just north of Salida, in November, 1907. Nearly all trapped at this point were in soiled pelage, the dorsal fur being of a dark olive-greenish cast, while the underparts were heavily tinged with dirty plumbeous. Mr. J. W. Frey, of Salida, accounts for this soiling by the statement that the prevailing westerly winds carry the smoke of the Salida smelter to the east side of the valley, where much of the time it hangs in a dense pall, soiling the vegetation and, indirectly, the mice which come in contact with it. Kangaroo rats living on the same sand flats were somewhat smoke-soiled, but not to the same extent.

P. m. rufinus appears to be as strictly nocturnal as the other deermice. In the little cabin on the edge of the cliffs just above the Spruce Tree Cliff Ruins, at the head of Navajo Canyon, on the Mesa Verde, I heard these mice squeaking about midnight of June 13. A faint squeak in one end of the cabin elicited answers from other parts of the building, and the noise was kept up for some time.

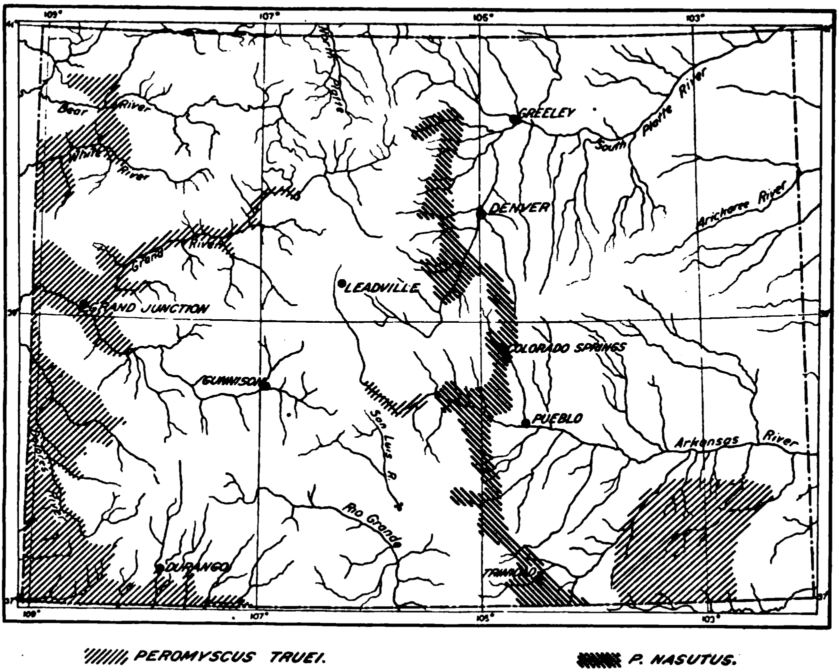

FIG. 11.—Distribution in Colorado of cliff mice (*Peromyscus truei* and *P. nasutus*).

Peromyscus truei (Shufeldt). True Cliff Mouse.

This large-eared species has a wide distribution in the warmer parts of western Colorado, where in common with many other Upper Sonoran mammals its range is practically coextensive with the juniper and pinyon belt. (See fig. 11.) It has been taken also in the juniper country of the southeastern corner of the State, and Warren has it from Salida and Parkdale, in the upper Arkansas Valley. Over much of its range in northwestern Colorado this species and the smaller-eared *nebrascensis* occur together, and in the southwest it is usually associated with *P. auripectus* and *rowleyi*.

The True cliff mouse almost always lives in the cliffs and rocky ledges along canyons or in hollow junipers and pinyons. In the dense juniper growth at the northern base of the Escalante Hills it was very abundant and was taken in traps placed in and around hollow junipers.

In the Grand River Valley it ranges east to McCoy, Eagle County. Although taken in Montezuma County, both on the Mesa Verde and in the McElmo Canyon, it does not appear to be so common there as *auripectus*. At Coventry it was abundant in rocky ledges among the pinyons and along the cliffs bordering Naturita Creek, where it was associated with both *rowleyi* and *auripectus*. Most of those taken at this point in July, 1907, were from half to two-thirds grown.

I found *P. truei* common in the rocky canyons and juniper country near Gaume's ranch in northwestern Baca County, and also collected a specimen in the rocky ledges at Rhinehart's Stage Station, on the plains of southern Prowers County, 20 miles south of Lamar. Prof. Lantz has taken it in southeastern Otero County, 18 miles south of La Junta.

Although this species almost invariably inhabits the Upper Sonoran zone, I have taken it once in the aspen forest in the Canadian zone. This was at the Club ranch, near Uncompahgre Butte, at the extreme head of Mesa Creek, at nearly 9,000 feet. An adult female was caught in a trap set beneath a log lying in a boggy aspen thicket July 17, 1907. There was none of the normal environment of *truei*—rocky pinyon or juniper slopes—within a mile or within a vertical distance of fully 1,500 feet, and this individual must have reached this high elevation from the lower country by following up one of the numerous canyons heading on the upper western slopes of the Uncompahgre Plateau.

In September, 1906, a favorable opportunity was afforded for observing these interesting mice on White River a few miles west of Rangely. My tent was pitched in a dense *Lepargyrea* thicket, and a sack of oats proved a great attraction to white-footed mice. All night long they were darting noisily over the tarpaulin, climbing the tent walls, and investigating the provisions. In the early morning numbers of both *P. truei* and *nebrascensis* were seen running about, all intent upon transferring a winter's supply of oats from the sack to their nests in the thicket. I observed that one of the large-eared mice, meeting an individual of the other species, invariably retreated precipitately, and gained the oat sack only by the exercise of great caution. The True cliff mouse presents a most peculiar and striking appearance in life with its large protruding eyes and immense ears. It is remarkably agile and takes long leaps with the greatest ease.

Peromyscus nasutus (Allen). Estes Park Cliff Mouse.

Vesperimus nasutus Allen, Bull. Am. Mus. Nat. Hist., III, p. 299, 1891. Type from Estes Park, Larimer County, Colorado.

This large plumbeous species has been taken at a number of localities in the eastern foothills of Colorado, but its range has not been satisfactorily worked out. (See fig. 11.) While it has been found as high as 8,400 feet, its center of abundance appears to be in rocky situations along the lowest edge of the foothills. It has not been taken in Wyoming, but is common in many places in the foothills of the New Mexico mountains. It belongs to the large-eared group of white-footed mice and bears a close resemblance to *P. truei*. It may be distinguished from the latter species, however, by its somewhat smaller ears and grayer or more plumbeous coloration, while the skull is a little larger and has longer nasals and much smaller audital bullæ.

At Estes Park (the type locality), Edward A. Preble secured specimens in a rocky gulch near the summit of a hill bordering the park, at 8,400 feet. Dr. Fisher found the species common in crevices in the rocky rims of the table mountains near Trinidad. Other members of the Biological Survey have taken it at Boulder, Gold Hill, and Canon City. Warren reports it as common in the vicinity of Colorado Springs, "both in the foothills and in the bluffs to the north and east of the city."[1]

Peromyscus boylei rowleyi (Allen). Rowley Cliff Mouse.

Specimens of this large long-tailed species from Arboles, Mesa Verde, and Coventry in the Biological Survey collection, and others from Cortez, Salida, and Irwin's ranch (Las Animas County), identified for Warren, represent all the information available on its distribution within the State. Noland's ranch, Utah (the type locality), is situated on the San Juan River within a few miles of the Colorado line. The Rowley cliff mouse is an Upper Sonoran species inhabiting rock ledges and cliffs in the juniper belt and probably occurs over most of the lower country in southwestern Colorado. It probably reaches Salida, in the upper Arkansas Valley, from the south and east, since Warren found it in the juniper country of northeastern Las Animas County. There are no specimens from the San Luis Valley, and hence it seems unlikely that it has reached the upper Arkansas region over the Poncha Pass.

At Coventry, Montrose County, where a small series representing both sexes was collected in July, 1907, I found *P. rowleyi* and *P. truei* about equally abundant in some low rocky ledges in a dense growth of pinyons. A long line of traps placed along the high and nearly naked cliffs bordering Naturita Creek yielded fewer specimens of *rowleyi* and more of *truei*. Most of the cliff mice taken at this season were half or two-thirds grown. Near the Spruce Tree Cliff Ruins, on Mesa Verde, at an elevation of 7,000 feet, an adult male *rowleyi* was trapped in a *Microtus* runway among the fallen leaves in an oak thicket. Tracks of a large cliff mouse were abundant in the fine chalk-like dust among all the cliff ruins examined on the Mesa Verde, but, as I had no time for careful trapping, it was impossible to determine which of the two species, *truei* or *rowleyi*, was more abundant. The Rowley cliff mouse was not taken at Ashbaugh's ranch, in the lower McElmo Canyon, but is doubtless present there, since Warren has two specimens from Cortez, near the head of McElmo Canyon. Arboles appears to be near the eastern limit of dispersion in the valley of the San Juan. Traps placed among the dry rock ledges on the north side of the San Juan at this point, June 7, 1907, yielded two immature specimens and one adult.

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[1] Mammals of Colorado, p. 247, 1906.

Peromyscus crinitus auripectus (Allen). Golden-breasted Canyon Mouse.

The type locality of this beautiful mouse is Bluff City, Utah, on the San Juan River, 40 miles west of the Colorado line. It inhabits the rock ledges and cliffs in much of the rough canyon and mesa country of western and southwestern Colorado, in the Upper Sonoran zone, becoming increasingly numerous toward the extreme southwest. It ranges northeast in the Grand River Valley to the Grand Canyon, east of Glenwood Springs, but was not found on the lower White River or at any point north of the Book Cliffs, and this high escarpment doubtless forms the northern boundary of its habitat. This mouse is usually associated with *P. truei*, but does not range so high. It appears to be restricted to the warmest valleys below 6,500 feet.

I first met with the golden-breasted mouse in the canyon of Plateau Creek, 5 miles east of Tunnel, Mesa County, where a female was trapped among the rocky ledges. It was again found at three widely separated localities in Montezuma and Montrose Counties. A specimen was secured among the Spruce Tree Cliff Ruins on Mesa Verde, and five specimens, representing both sexes, were collected in the rock ledges and cliffs bordering McElmo Creek at Ashbaugh's ranch, 20 miles west of Cortez. At Coventry, Montrose County, *P. auripectus* is greatly exceeded in numbers by both *truei* and *rowleyi*. I trapped a single specimen at this point in the rocky cliffs north of Naturita Creek. Mr. C. H. Smith, of Coventry, has collected a number of the golden-breasted mice among the same cliffs and does not consider them at all rare. Warren has this species from Grand Junction. Thus far it has not been found at any point in the Gunnison Valley, but this is doubtless owing to lack of careful collecting in that region.

Reithrodontomys montanus (Baird). Mountain Harvest Mouse.

Reithrodon montanus Baird, Proc. Acad. Nat. Sci. Phila., p. 335, 1855. "Vicinity of the Rocky Mountains, lat. 38°." Type locality restricted by Allen (Bull. Am. Mus. Nat. Hist., VII, p. 125, 1895) to "upper part of the San Luis Valley."

The type specimen of this interesting little harvest mouse in the National Museum was collected by F. Kreuzfeldt on Capt. E. G. Beckwith's expedition to the Pacific coast in August, 1853, and until recently remained unique. The exact locality is indeterminate, but from the itinerary appears to have been on the east side of the San Luis Valley about one-third the distance between old Fort Massachusetts (near Fort Garland) and Cochetopa Pass—probably not far from the San Luis Lakes.

Vernon Bailey collected a harvest mouse at Del Norte in September, 1903, but it was so immature as to throw little additional light on the status of Baird's *montanus*. The Del Norte specimen was trapped "under a bunch of *Sarcobatus* at the edge of an alfalfa field."

Considerable areas of swamp land and wet meadows in various parts of the San Luis Valley furnish an ideal environment for harvest mice. When in the region, in October, 1907, in quest of specimens of *montanus*, I visited the Medano Springs ranch, 15 miles northeast of Mosca and a short distance northeast of the San Luis Lakes, as this seemed very near where the type specimen must have been taken. Here the extensive hay meadows and marshes along Medano Creek appeared well suited to harvest mice; but after trapping carefully for a week in wet situations without success and taking meanwhile one adult and three young in the rank grass beneath *Sarcobatus* bushes on higher ground, I decided that *montanus* must be sought in dry situations. Accordingly, during the first week in November, all the traps were placed in a grassy weed patch on a broad sand ridge extending through the meadows and perhaps 6 feet above their level. Most of the specimens collected at this time were caught in traps placed in the dense growth of grass beneath the bushes of rabbit brush (*Chrysothamnus patens*), which occupied one end of the sand ridge. A very few were taken among the scattering dry stalks of *Peritoma sonoræ*. The series of 13 males and 7 females collected contains only 4 or 5 adults. Doubtless many more of this species would have been taken had the majority of the traps not been filled each night with voles and white-footed mice, which were exceedingly numerous in both wet and dry situations.

This is probably an isolated intermountain species. Its known range is indicated by Del Norte, Medano ranch, and Crestone, Warren having taken it at the last-named place in early October, 1909. (See fig. 12.)

A. H. Howell, of the Biological Survey, who has in preparation a revision of the genus *Reithrodontomys*, has compared with related forms the topotype series of *R. montanus* from Medano Springs ranch. The following characterization is from his manuscript:

"*General characters.*—Size small (about the size of *humilis*); ears and tail short; colors pale.

"*Color.*—(Fresh winter pelage, October and November). Pinkish buff, clearest on sides and face, much mixed with blackish on dorsal surface. Black hairs, most pronounced on hinder back. Ears much as in *megalotis*, usually clothed on inner surface with ochraceous buff hairs (a little darker than body hairs), sometimes, though not always, with a distinct blackish area on lower margin. Tail distinctly bicolor—grayish brown above, white beneath. Compared with *megalotis*, the general tone is paler and less brownish; dorsal area more distinct from color of sides; sides pinkish buff instead of ochraceous buff; tail grayer (less brownish).

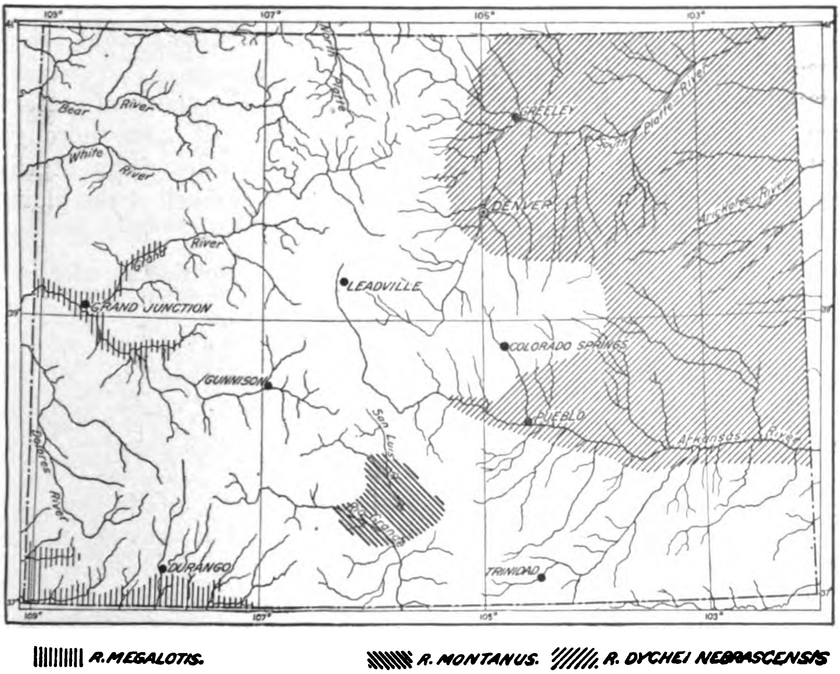

FIG. 12.—Distribution in Colorado of harvest mice (*Reithrodontomys*) except *R. albescens*.

"*Cranial characters.*—Skull about the same size as that of *humilis*, but with narrower rostrum and interorbital region; zygomata narrowing anteriorly; nasals longer; molars heavier. Compared with *megalotis* the resemblance is very close; *montanus* averages smaller, with narrower and relatively higher brain case.

"*Measurements.*—Average of 10 specimens from Medano Springs ranch: Total length, 126 (118–139); tail vertebræ, 58 (51–64);

hind foot, 17 (16–17.5). Average of three skulls: Occipito-nasal length, 20.2; breadth of brain case, 9.4: length of nasals, 7.9."

R. montanus is a small, short-tailed species related to *R. albescens* and *R. griseus*, and, like these, frequents dry grassy situations. Compared with *R. megalotis*, it may be distinguished by its smaller size, paler coloration, and shorter ears and tail. From the pale grayish form *albescens* of the Nebraska sand hills, *montanus* differs in darker (less gray) coloration, and somewhat larger ears, while the skull is relatively longer and narrower and the rostrum longer than in *albescens*.

Reithrodontomys montanus albescens Cary. Pallid Harvest Mouse.

Four specimens of harvest mice from Loveland in the Miller collection seem referable to *R. m. albescens*, although somewhat intermediate in characters between *albescens* and *griseus*. The relative abundance and distribution of harvest mice on the plains of eastern and northeastern Colorado will not be known until more thorough collecting is done. Possibly *albescens* or some other form of the short-tailed group occurs with *R. nebrascensis* over much of the plains region, as in western Kansas and Nebraska.

Reithrodontomys dychei nebrascensis Allen. Nebraska Harvest Mouse.

The Nebraska harvest mouse doubtless occurs over most of the plains region east of the foothills in the northern two-thirds of the State. (See fig. 12.) There are specimens from Denver, Golden, Valmont, Boulder (5 miles west), Loveland, Greeley, and Canon City, but none have been taken on the plains south of the Arkansas Divide. The species is usually taken in wet meadows, in alfalfa fields, or along the grassy margins of irrigation ditches, but may be found also in smaller numbers on dry uplands where there is a sufficiently heavy growth of grass and weeds. Harvest mice range a short distance into the foothills, along some of the streams, following the widest and warmest valleys. I trapped one specimen at Blanchard's ranch, on Middle Boulder Creek, 5 miles west of Boulder. It was taken in a grassy swale along the stream at 5,600 feet, in the Transition zone. At Wray one was seen in a tangle of willow brush in the boggy bed of a canyon, where in moving about in the brush it often wrapped its tail around a twig by way of assistance.

Reithrodontomys megalotis (Baird). Big-eared Harvest Mouse.

This large-eared desert harvest mouse ranges into the State from the west and southwest, following the low Upper Sonoran valleys. It is not known to occur north of the Grand River Valley. (See fig. 12.)

At Arboles, in southwestern Archuleta County, near the New Mexico boundary, a female was taken in a trap set in the short grass beneath a dense growth of willows and buffalo berry (*Lepargyrea argentea*) on the bank of the San Juan River. Two males taken from six traps set in a tule marsh along McElmo Creek at Ashbaugh's ranch, Montezuma County, during the night of June 19, 1907, indicate that harvest mice are tolerably common in that locality. I collected one at Hotchkiss August 9, beneath a low rocky ledge bordering a small tule marsh along the North Gunnison River. This specimen was nearly eaten up by other mice, but the skin of back and rump which I preserved is grayish and does not at all resemble the usual fulvous summer pelage of *megalotis*. This species is not by any means restricted to marshes and damp situations, as was shown by two specimens trapped among beds of *Opuntia* on a high sand knoll in the Grand Valley near Morris, 7 miles west of Rifle, August 13 and 14. These specimens, a male and a female, are gray, like the Hotchkiss example. The female contained six fetuses. A series of 25 specimens taken by Howell at Grand Junction early in November, 1895, are in early winter pelage; while another individual which Preble secured at the same locality August 25, 1895, is in the bright fulvous summer coat. Warren has a specimen from Cortez, Montezuma County.

Neotoma cinerea orolestes Merriam. Colorado Bushy-tailed Wood Rat.

Neotoma orolestes Merriam, Proc. Biol. Soc. Wash., IX, p. 128, July 2, 1894. Type from Saguache Valley (20 miles west of Saguache), Colorado.

Bushy-tailed wood rats are common throughout the mountains and also in the rough juniper and pinyon country of western Routt and Rio Blanco Counties. On the eastern slopes of the main ranges they rarely occur below 6,000 feet, and are largely replaced in the lower foothills by the smaller round-tailed *N. fallax*. They have been found from an elevation of only 4,500 feet at Grand Junction to timberline on Mount McClellan and near Silverton, thus having a vertical range of approximately 6,000 feet. (See fig. 13.) Specimens from the lower arid western portions of Routt and Rio Blanco Counties are usually much paler than those from the main mountain ranges.

In 1905 and 1906 I observed *N. orolestes* in all the mountainous country traversed. It was least common in the Middle and North Park region, where a few stick nests were noted in the cliffs along Grand River and in the Rabbit Ear Mountains, and one rat was seen in an old cabin near Fraser. In the rough country bordering the lower Snake and Bear Rivers the favorite homes of this species are in hollow junipers, which are often completely filled with sticks, cactus pads, bones, and other nest material. In this region the rats live also among the rocky bluffs, in hollow cottonwoods along the streams, in the adobe banks of arroyos, and occasionally in thickets of buffalo berry. One nest noted on Snake River was in a buffalo berry bush fully 10 feet above the ground. The few old cabins which I entered in the Snake River Valley below Baggs Crossing were inhabited by numbers of rats, in addition to two or three species of bats and innumerable white-footed mice. The cupboard, stoves, shelves, and bunks were filled with trash carried in by the rats, and an immense pile of rubbish had been piled up in a corner of one of the cabins. I often saw wood rats running about in the cabins during the daytime, and on Bear River shot one among the rocks at midday. At one of our Snake River camps wood rats were very abundant and all night long could be heard climbing the tent walls, investigating our supplies, and running back and forth across our blankets. One was bold enough to nip my companion's ear.

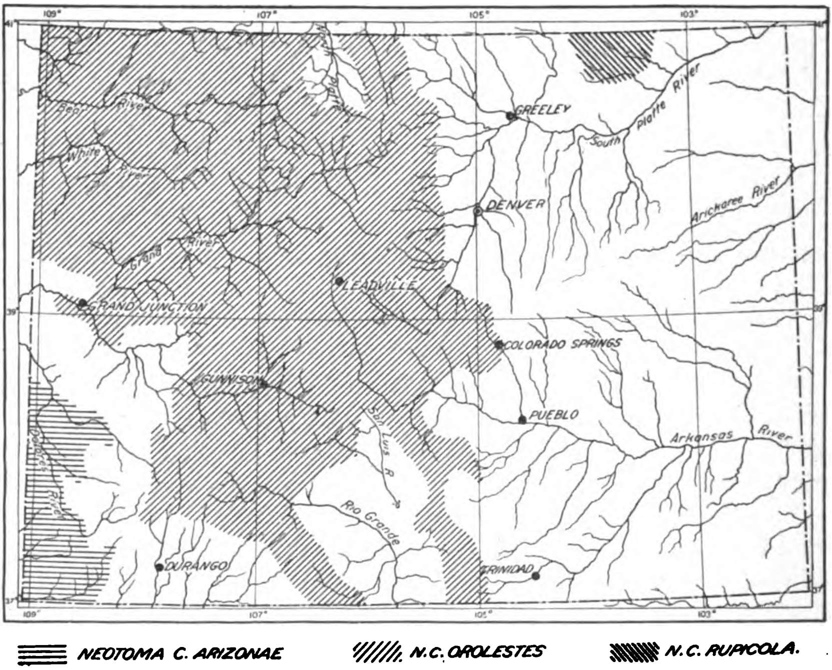

FIG. 13.—Distribution in Colorado of bushy-tailed wood rats (*Neotoma c. arizonæ, N. c. orolestes*, and *N. c. rupicola*).

Supposed nests of *N. orolestes* were seen at Sapinero, Somerset, and on the Uncompahgre Plateau in 1907, and the species was reported at St. Elmo, in northwestern Huerfano County, and at many other localities. Bailey reports it common in the canyon of Conejos River, west of Antonito. It is represented in the Biological Survey collection by specimens from a wide range of localities in the Colorado mountains.

In its propensity for carrying rubbish into deserted cabins this species resembles other members of the genus, and it also shares with them the habit of hiding in its nest all manner of portable articles which attract its fancy. The industry of these rats is remarkable, and a pair can accomplish a surprising amount of work in one night. On the lower Snake River a stick nest of considerable size was built near the oat sack in our camp wagon while we slept, and a wood rat was found early the next morning domiciled therein.

The nests are found in a variety of situations. In the mountains they are usually placed in cracks and crevices of rocky ledges and cliffs or in deserted cabins. Miners at the Stevens Mill, at timberline on Mount McClellan, reported a few rats living in the mine several hundred feet from the entrance, and stated that the animals often passed them on the ladders.

Neotoma cinerea arizonæ Merriam. Arizona Bushy-tailed Wood Rat.

Bushy-tailed wood rats from Ashbaugh's ranch (near McElmo), Montezuma County, and from Coventry, Montrose County, are referable to this small southwestern species. Warren has taken it at Cortez, Montezuma County, and at Bedrock, Montrose County, and it appears to be the species so common among the cliff ruins on Mesa Verde. It is mainly Upper Sonoran in distribution, and probably does not occur north of the San Miguel Valley (see fig. 13), since *N. orolestes* is the species found in the Grand Valley at Grand Junction. Intergradation between *arizonæ* and *orolestes* probably takes place in the region of the Uncompahgre Plateau, but there are no specimens to decide this point.

The Arizona wood rat is uncommon at Coventry, being greatly outnumbered by the little gray round-tailed *N. fallax* in the cliffs along Naturita Creek. In the cliffs at Ashbaugh's ranch, also, I found both species occurring together, but here the bushy-tailed rats were more numerous, The nests of the two are apparently indistinguishable, and both species were taken in traps set at the same nest. One of the yellowish bushy-tailed rats was seen running along a rocky ledge about 4 o'clock one afternoon. Its course led from one sheltering rock to another and obliged it to cross short intervening spaces of sunlight. The rat took advantage of all the shadows and dark recesses, and when forced to cross a bright open space its movements were so quick that the eye could scarcely follow. Other rats were dimly seen moving about in nests far back under rocks.

Many wood rat tracks which I saw in the fine dust of the Spruce Tree Cliff Ruins (see Pl. IV, fig. 1) on Mesa Verde, as well as fresh stick nests found in the neighboring rock ledges, indicated an abundance of the animals at this point—doubtless both *fallax* and *arizonæ* being present. Large piles of well-preserved rat excrement found in many of the rooms among the ruins were apparently as old as the ruins themselves, being blackened with the same smoke which begrimed the interior of the rooms and caverns centuries ago.

Neotoma cinerea rupicola Allen. Pallid Bushy-tailed Wood Rat.

Eight specimens from Pawnee Buttes and the Chimney Cliffs (30 miles northwest of Sterling) agree closely with topotypes of *N. rupicola* from Corral Draw, Big Bad Lands, South Dakota. This interesting series greatly extends the known range of the species and gives the first record for Colorado. (See fig. 13.)

Near the Chimney Cliffs two nursing females, an adult male in badly worn pelage, and two young about quarter grown, were collected June 4 to 8, 1909, on the talus slopes and rocky buttes in the open valley a mile or so south of the cliffs. The rats probably inhabit all the buttes scattered here and there over the upper drainage of Horsetail Creek east to within 15 miles of Sterling. They appear to be uncommon, however, among the precipitous white badland cliffs which form the northern boundary of the Horsetail Valley. This may be because there are fewer natural crevices and recesses for nesting sites in the soft white rock of the badland formation. Rat nests were numerous beneath the bowlders and rock ledges on the buttes in the valley, as they were also in similar situations at Pawnee Buttes, some 25 or 30 miles southwest. The species appeared inactive at both localities, however, and I found it difficult to secure specimens. The two nursing females from the Chimney Cliffs are in fresh light yellowish summer pelage, while all the males taken are in worn and faded whitish winter pelage.

N. rupicola is the palest known member of the genus. It is a small form of the bushy-tailed group, inhabiting the rough areas of badland bluffs and buttes from western South Dakota south to northeastern Colorado, in the Upper Sonoran zone. I secured it in the bluffs along Laramie River at Uva, Wyoming, and it occurs also in the rocky bluff region of extreme western Nebraska.

Neotoma floridana baileyi Merriam. Bailey Wood Rat.

This is the only representative of the *Neotoma floridana* group in Colorado. It enters the State from the east, in the valleys of the Republican and Arkansas Rivers and tributary streams, and ranges westward along the Arkansas to Pueblo and farther north to Flagler and Wray. (See fig. 14.) It is restricted to the Upper Sonoran zone.

At Olney, in December, 1894, Mr. C. P. Streator found this wood rat abundant in thickets of tree cactus (*Opuntia arborescens*) and collected a series of 12 specimens. He was informed by stockmen that a few are found 10 miles north of Arlington, Kiowa County, and also along the Arkansas River south of Chivington. Concerning the distribution of *N. baileyi* in the Arkansas Valley, Mr. Streator reports that it "evidently occurs wherever there are rocks, tree cactus, or hollow trees." He found it common also in the cliffs bordering the valley of the South Fork of the Republican River near

Flagler. It is abundant in the sandstone ledges bordering the South Fork Valley in the vicinity of Tuttle, where I captured specimens, and found the nests composed of sticks, dried cow manure, bones, and rubbish of all sorts, with cactus and yucca spines for protection. Prof. D. E. Lantz reports pack rats common in hollow cottonwoods along the Big Sandy near Hugo, and I found old nests among the rocks on the northern face of Cedar Point, northwest of Limon. This should be the form represented at both the above localities. At Wray, where I secured specimens, this rat was inhabiting sandstone ledges along the valley, much as at Tuttle. There is a specimen from Pueblo, and the rats are reported by Mr. H. W. Nash as common at that point.[1] The American Museum of Natural History has a specimen from Fort Lyon, on the Arkansas River, collected by Capt. P. M. Thorne February 4, 1885. This specimen has been recorded as *N. campestris*.[2]

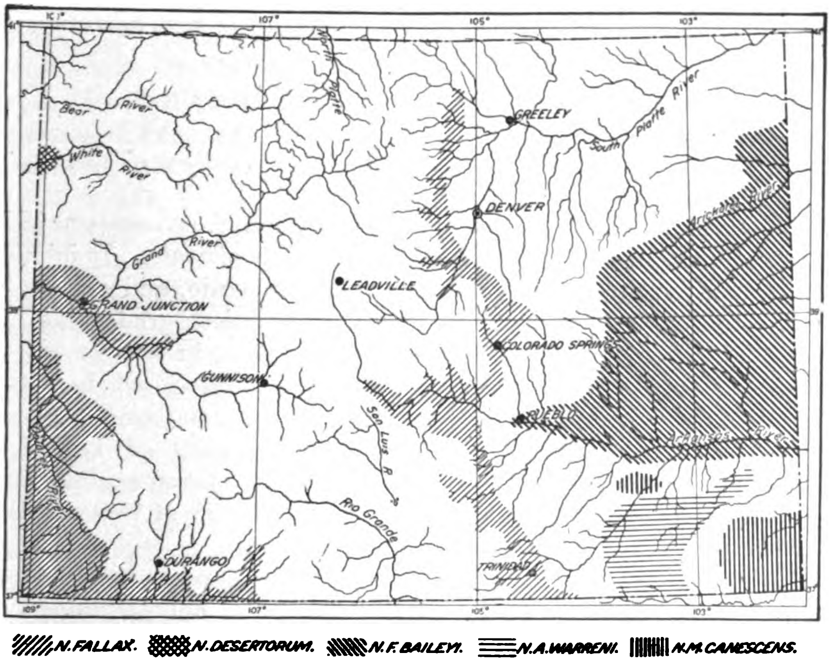

Fig. 14.—Distribution in Colorado of round-tailed wood rats (*Neotoma fallax*, *N. desertorum*, *N. f. baileyi*, *N. a. warreni*, and *N. m. canescens*).

Neotoma f. baileyi is a large, long-tailed, gray form of the round-tailed group, and quite unlike any of the other Colorado species.

Neotoma micropus canescens Allen. Hoary Wood Rat.

The hoary wood rat has been found only in the southeast corner of the State, in southeastern Otero County and in Baca County, this being the northern known limit. (See fig. 14.) A specimen taken by Warren at Monon, and sent to the Biological Survey for identification, proves referable to this form. Mr. Warren found this wood rat also at Springfield, and states that he found it living chiefly among rocks, but that some were living in the buildings of an unoccupied ranch. Near Higbee, Otero County, where Prof. Lantz secured a specimen in April, 1910, these rats were living among rocks and in hollow junipers on the mesas and in clumps of tree cactus (*Opuntia arborescens*) in the open Purgatory Valley. On the deserts of western Texas and over the greater part of its range the species lives in open country, the nests being usually in bunches of cactus or other spiny shrubbery.

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[1] Mammals of Colorado, p. 247, 1906.

[2] Allen, Bull. Am. Mus. Nat. Hist., VI, p. 322, 1894.

Neotoma albigula warreni Merriam. Warren Wood Rat.

Neotoma albigula warreni Merriam, Proc. Biol. Soc. Wash., XXI, pp. 143–144, June 9, 1908. Type from Gaume's ranch, northwest corner of Baca County, Colorado.

This medium-sized wood rat closely resembles *N. m. canescens* in its gray coloration, but its relationships are with *albigula*. It inhabits the rough juniper country of southeastern Colorado, and also occurs in northeastern New Mexico, where it doubtless grades into *N. albigula*. It is abundant in Shell Rock Canyon, in extreme northwestern Baca County, and Warren found it at Irwin's ranch, in eastern Las Animas County. It may be the species inhabiting the rock ledges at Rhinehart's stage station, 20 miles south of Lamar, in southern Prowers County, but no specimens were taken at that point. Doubtless it occurs throughout the juniper country of western Baca and eastern Las Animas Counties. (See fig. 14.)

At Gaume's ranch, in Shell Rock Canyon, I found these wood rats living among rocks along the canyon walls or in hollow junipers on the upper rims of canyons, and occasionally in large stick houses reared against the bases of junipers in the dense growth well back from the canyon rims. Whether among the rocks or in the junipers, the nests were fortified with a varied assortment of spines and thorns, the sharp spiny bundles of the tree cactus (*Opuntia arborescens*) always predominating. The stick houses averaged about 2 feet in height and often contained several bushels of dead juniper branches. Judging from the signs observed at the nest entrances, the rats were subsisting largely at this time of year (November) upon the berries of *Juniperus monosperma*.

According to Mr. E. J. Gaume, these rats seldom take up their abode in abandoned houses as do the "short-tailed blue rats" (undoubtedly referring to *N. m. canescens*) of eastern Baca County. Regarding the habits of this species at Gaume's ranch, Warren says: "It did not seem to breed as early as *N. micropus* [*N. m. canescens*] at Monon, for half-grown young of the latter species were taken the 1st of May, while the present species was apparently just beginning to breed after the middle of the same month."[1]

Neotoma fallax Merriam. Gale Wood Rat.

Neotoma fallax Merriam, Proc. Biol. Soc. Wash., IX, p. 123, July 2, 1894. Type from near Gold Hill, Boulder County, Colorado.

The type specimen of this small gray round-tailed wood rat was taken by the late Mr. Denis Gale on a tributary of Boulder Creek, near Gold Hill, at the extreme upper limit of the range of the animal. Other specimens in the Biological Survey collection are from the following localities, chiefly in the lower eastern foothills: Boulder; Arkins; Loveland; Canon City; Trinidad; Fisher Peak; Martinsen, Las Animas County; Arboles; near McElmo; and Coventry. Specimens from Colorado Springs, Spring Canyon (near Fort Collins), and Grand Junction have been sent to the Biological Survey for identification. Other localities from which Warren has specimens are Cortez, Salida, Van Andert's Spring (on Little Fountain Creek, southwest of Colorado Springs), and Howard.

N. fallax is common among the eastern foothills north across the State as far as Fort Collins. It occurs from the lowest outlying talus slopes at the edge of the plains to an altitude of about 7,500 feet, mainly in the Transition zone. (See fig. 14.) In the Canadian zone it is replaced by the larger bushy-tailed *N. orolestes*. The two species occur together at a number of localities (including the type locality of *N. fallax*) between 6,000 and 7,000 feet; and at Blanchard's ranch, 5 miles west of Boulder, both have been taken at 5,800 feet. Throughout this region of vertical overlapping of ranges (about 2,000 feet), however, *fallax* is the commoner species. Warren has taken both species at Grand Junction, below 5,000 feet.

From Trinidad this species probably extends south in the Upper Sonoran and Transition zones around the southern ends of the Culebra and San Juan Ranges, thus reaching southwestern Colorado from the south, rather than from the east through the lowest mountain passes. At Pagosa Springs, Arboles, and Bayfield it inhabits rock ledges—at Pagosa Springs in gulches in the yellow-pine forest and at the last two localities down among the pinyons. It is also common with *N. arizonæ* in the cliffs along McElmo Creek at Ashbaugh's ranch, Montezuma County, and on Naturita Creek at Coventry, at the last locality being occasionally found about ranch buildings. This seems to be the species commonly known in the lower parts of western Mesa, Montrose, and San Miguel Counties as the sleek-tailed rat. Fresh nests were found beneath the rocky ledges on Dry Creek, west of Naturita, and others in the Sinbad Valley, near Uranium. A very few nests seen in the bluffs along the North Gunnison River near Hotchkiss appeared to belong to *fallax* rather than to *orolestes* It is not known from the San Luis Valley, but careful collecting on the lower slopes of the bordering mountains may prove its presence in that region.

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[1] Mammals of Colorado, p. 248, 1906.

In its habits *fallax* does not differ materially from the other wood rats. It is equally at home in deserted mines, prospect holes, cabins, and among rocks; while a talus slope seems peculiarly attractive to it. The type specimen was taken in a stamp mill. Near Canon City Bailey found several nests in hollow junipers, and in southwestern Colorado I have often seen nests in junipers and in pinyons. The piles of sticks, stones, and other trash accumulated by these rats among the rocks and on talus slopes are not so large as in old cabins. The stove in a cabin which I entered near Gold Hill was completely filled with sticks and rubbish, while the nest in the oven was composed of softer materials. Among the varied assortment of nest materials used by this wood rat may be mentioned juniper branches, sticks, stones, bones, dried horse dung, pads of prickly pear cactus (*Opuntia*), and the branches of a variety of thorny and spiny plants, such as roses, haws (*Cratægus*), *Ceanothus fendleri*, and yuccas. The inner nest is often composed of the soft inner bark of the juniper. At Walsenburg and Badito, in Huerfano County, and also in the bluffs along the San Juan River at Arboles, these rats often construct their nests entirely of the spiny branches of tree cactuses (*Opuntia arborescens* and *O. whipplei*).

A female wood rat which I surprised in her nest among the rafters of a cabin near Boulder, July 23, 1906, glided away like a shadow in the semidarkness, with two young about quarter grown clinging to her teats. Her movements were rapid but perfectly noiseless. A female collected by Loring at Loveland contained three small fetuses May 1, while an immature individual from near McElmo, June 18, is about two-thirds grown. Acorns, pinyon nuts, and juniper berries are the chief food of *fallax* in southern Colorado, judging from the quantities found in and around some of the nests.

This wood rat appears to be chiefly nocturnal, but as we rode down the bed of a dry desert arroyo north of Nucla, Montrose County, on a hot day in July, one was seen dodging about among the bordering rocks at midday.

Neotoma desertorum Merriam. Desert Wood Rat.

The small desert wood rat reaches Colorado in the extreme lower White River Valley, in the vicinity of Rangely (see fig. 14), where it meets the range of the larger, bushy-tailed *N. orolestes*. A number of the nests of *desertorum* were found on the first bench south of White River, 5 miles west of Rangely, at 5,300 feet, where four of the rats were collected September 15 and 16, 1906. These nests, or houses, were 2 or 3 feet in height, and were constructed of dried cow manure and the pads of prickly pear. Scattered here and there over the cactus flat they looked curiously like muskrat houses on a marsh. (See fig. 15.) The rats were trapped at the entrances to the nests, of which there were usually two above ground, and often a third opening beneath a bush a yard or so distant. The largest of the houses were in thickets of *Atriplex confertifolia*, but the smaller structures were reared in bunches of *Opuntia*. Specimens of *N. desertorum* and *orolestes* were taken within a few feet of each other, the latter species living in the banks of the dry arroyos which border the flat occupied by the small *desertorum*.

I did not find the species in the desert areas of southwestern Colorado in 1907, although much of the region seems suitable.

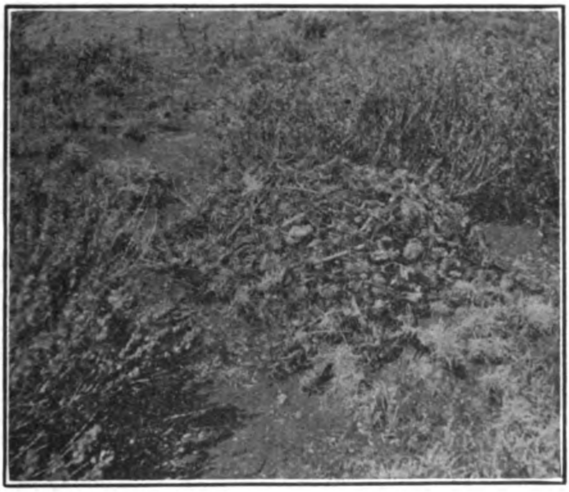

FIG. 15.—Nest of *Neotoma desertorum* on *Atriplex* flat near Rangely.

Phenacomys orophilus Merriam. Mountain Phenacomys.

An adult female *Phenacomys* which Warren collected December 11, 1906, at Lake Moraine, El Paso County, and forwarded to the Biological Survey for identification, proves referable to *P. orophilus* of the northern Rocky Mountains, and is quite distinct from *P. preblei*, taken on Longs Peak. The Lake Moraine specimen differs from the type of *preblei* in its larger size, more robust skull, and particularly in its much grayer pelage. The fur is full and long and of a beautiful frosted gray color, while the feet and tail are almost white. The measurements are: Total length, 140; tail vertebræ, 30; hind foot, 18. Warren secured this specimen near Ruxton Creek, at 10,250 feet, "in a hole near creek bank." An imperfect skull in the National Museum which belongs to an alcoholic specimen (No. 59691, Fairplay, Park Co., July 11, 1873) is large and robust as compared with the skull of the type of *P. preblei*, and accords well with the Lake Moraine specimen. The skin has lost its color value through long immersion in alcohol. The altitude of Fairplay is about 9,900 feet.

Little is known of the habits of these interesting short-tailed mice. They appear to be very rare in Colorado and restricted to the mountains above 9,000 feet. At present they are known only from the higher eastern slopes of the Front Range, in the Canadian zone.

Phenacomys preblei Merriam. Preble Phenacomys.

Phenacomys preblei Merriam, Proc. Biol. Soc. Wash., XI, p. 45, March 16, 1897. Type from Lilie Mountain, near Longs Peak, Colorado.

The type of this small pale ochraceous species, an adult male, has until recently remained unique. It was collected August 12, 1895, by Mr. Edward A. Preble on Lilie Mountain (known also as Twin Peak), not far from Longs Peak. Preble states that the exact locality was on a southwest slope of the mountain not far from Lamb's ranch, at an elevation of approximately 9,000 feet. The specimen was taken in a trap set for white-footed mice among fallen logs on a dry slope supporting scanty vegetation. This slope had been covered by trees, most of which had fallen.

Another specimen, an adult female, from North Boulder Creek, near Nederland, has been recorded recently by Mr. R. T. Young,[1] who secured it on the Silver Lake trail September 19, 1900, at an elevation of between 9,000 and 10,000 feet. This specimen, which is in the Philadelphia Academy of Natural Sciences, I have been permitted to examine through the courtesy of Mr. Witmer Stone. It is a well-made skin and has a perfect skull, which is more robust than the skull of the type of *P. preblei*, with the interorbital ridges well developed (inclosing a median sulcus). The skin measurements are: Total length, 143; tail, 33; and hind foot, 18; as compared with 130–30–17 of the type of *P. preblei* (a male), and 146–38–19 of the type of *P. orophilus* (a female). In coloration the Nederland specimen is nearest *P. preblei*, it being much too yellowish for *orophilus*, with the back and sides strongly suffused with ochraceous.

Evotomys gapperi galei Merriam. Rocky Mountain Red-backed Mouse.

Evotomys galei Merriam, N. Am. Fauna No. 4, p. 23, pl. II, fig. 3, 1890. Type from Ward, Boulder County, Colorado (9,500 feet).

In Colorado red-backed mice are restricted to the boreal forests of the high mountains. Their center of abundance is in the lodgepole pine forest belt of the Canadian zone, but they range up to at least 11,000 feet, in the Hudsonian zone, well within the Engelmann spruce belt. Cold, mossy, heavily forested slopes having a great deal of fallen timber are most frequented by red-backed mice, which live beneath the rotten logs and brush piles. They seem to be largely nocturnal, although one July afternoon I saw one running along under a log at Petersons Lake, west of Eldora, Boulder County. In most parts of the mountains they are difficult to trap owing to the greater abundance of field mice and white-footed mice, which get into the traps early in the night. For this reason it is often impossible to judge whether red-backed mice are common or rare, but it seems certain that in most sections they are greatly outnumbered by other species. At the type locality, however, Preble found them abundant and caught nothing else in his traps.

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[1] Proc. Acad. Nat. Sci. Phila., p. 406, 1908.

During the field seasons of 1905 and 1906 eleven specimens were taken at four widely separated localities in northern Colorado. In July, 1905, five were trapped beneath fallen logs in dry lodgepole pine forest at Coulter, Middle Park (8,500 feet); three more were caught August 16 in a thicket of balsam (*Abies lasiocarpa*) in the aspen forest on the White River Plateau, 25 miles southeast of Meeker, at the same altitude; August 10, 1906, an immature male was secured in a bog near Pearl, in the northern end of North Park; and in late September three others were captured in the Douglas spruce forest at Baxter Pass, on the summit of the Book Plateau, within a few miles of the Utah boundary. In October, 1907, I found *Evotomys* tolerably common in mossy spruce woods and thickets near St. Elmo in the Saguache Mountains, at 10,000 feet. Most of the individuals trapped at this point were half or two-thirds grown. Other specimens are from Gold Hill, Longs Peak, Lake City, and Silverton.

The type of *E. galei*, which is in the Merriam collection, was taken by Mr. Denis Gale at Ward, July 13, 1889. The National Museum has specimens from the Silver Lake trail, near Nederland, Boulder County; and others labeled Twin Lakes and Del Norte.[1] Warren records this species from Crested Butte and Irwin, Gunnison County; Divide, Teller County; Lake Moraine, and mountains near Colorado Springs, El Paso County.[2]

Microtus pennsylvanicus modestus (Baird). Saguache Meadow Mouse.

Arvicola modesta Baird, Mamm. N. Am., p. 535, 1857. Type from "Sawatch Pass, Rocky Mountains" (Cochetopa Pass, Cochetopa Hills, Colorado).

This large, dark meadow mouse is common on the plains at the eastern base of the foothills and in the San Luis Valley region of southern Colorado, but is apparently rare in the northern mountains. Small colonies are found in marshes at Golden and Valmont, and at Medano Springs ranch, near the San Luis Lakes, the species was extremely abundant, not only in marshes and wet meadows, but also on grassy uplands and wherever any cover was afforded. A small colony of meadow mice found in an alkaline marsh near the mouth of Four-mile Creek, Routt County, and others reported in the McElmo Valley, in western Montezuma County, may have been of this species, but no specimens were secured at either locality.

In August, 1892, Loring collected a large series of topotypes at Tevebaugh's ranch, 9 miles south of Cochetopa Pass, where he found well-beaten runways ramifying through the tall grass near a creek. Six, seven, and even eight young were found by Loring in single nests, which were composed of fine dried grass and were said to resemble the nest of the ovenbird. Bailey found this meadow mouse very abundant in both dry and wet meadows along the Rio Grande at Del Norte, where it was doing slight damage in clover and alfalfa fields. At Wray,[1] in May, 1909, these meadow mice were feeding extensively upon the blossoms and leaves of the false Solomon's seal (*Vagnera stellata*), and fragments of the blossoms of a species of *Senecio* were also found scattered along the runways.

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[1] Probably from some point in mountains near Del Norte.

[2] Mammals of Colorado, p. 249, 1906.

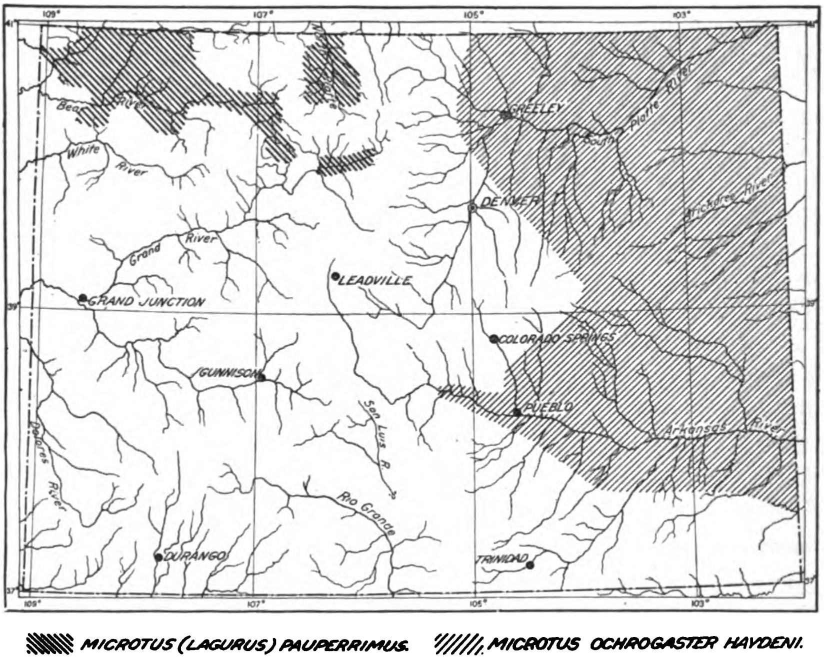

FIG. 16.—Distribution in Colorado of Hayden and pygmy field mice (*Microtus pauperrimus* and *M. ochrogaster haydeni*).

In addition to the series mentioned above, the Biological Survey has specimens of *M. modestus* from Denver, Loveland, Antonito, and Fort Garland. A specimen in the National Museum is from Twin Lakes; some from Fort Collins have been identified for S. Arthur Johnson; and Warren has others from Colorado Springs, Westcliffe, and Divide. The species is recorded from Estes Park.[2]

Microtus ochrogaster haydeni (Baird). Upland Mouse.

The upland mouse has been taken in Colorado at only a few localities along the eastern base of the foothills, and at Wray and Tuttle, near the eastern border. (See fig. 16.) It is doubtless present, however, over most of the dry uplands and prairies east of the mountains and north of the Arkansas Valley. Unlike *M. modestus*, which inhabits damp meadows and marshes almost exclusively, *haydeni* is usually, though not always, found on high grassy plains. On my trip across the plains from Cheyenne Wells to Sterling in 1909, I collected a young individual at Wray in a cold bog inhabited by a large colony of *modestus;* while at Tuttle four upland mice were taken in a marsh along the South Fork of the Republican River, and signs of them were seen on a grassy flat on the dry upland 8 miles south of Seibert. Other localities from which the Biological Survey has specimens are Loveland, Canon City, and Fort Collins. The species is reported from Greeley.[1]

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[1] Several specimens collected in the cool canyon bogs at Wray are abnormally dark, but can be matched by a few specimens from elsewhere in the range of *modestus*.

[2] Mammals of Colorado, p. 250, 1906.

Microtus mordax (Merriam). Rocky Mountain Field Mouse.

This large, long-tailed field mouse has been taken from an elevation of 4,600 feet (Grand Junction) to considerably over 12,000 feet (Mount Kelso),[2] and thus has the widest vertical range among the Colorado species of *Microtus*. It is abundant throughout the Canadian and Hudsonian zones of the mountains, and follows down cold streams in places through the Transition zone. It is of little economic importance, owing to the very limited agriculture carried on within its range.

This species is fond of forests and of cool, damp situations where the vegetation is rank. On Mount Kelso, near Grays Peak, several large colonies were discovered in dense thickets of alpine willows (*Salix chlorophylla* and *S. glaucops*) considerably above timberline. Most of my specimens were taken under logs in heavy forests or in cold mountain bogs grown up with willows. In many localities the field mice were so abundant that all the traps would be thrown by them during the early evening hours, and thus my chances for the rarer mammals were spoiled. I found a small colony at Rangely in a marsh bordering White River at 5,300 feet, and another on a small tributary of the San Miguel River near Coventry at about 5,500 feet. This species is represented in the Biological Survey collection by specimens from a wide range of localities in the mountainous parts of the State.

Microtus nanus (Merriam). Dwarf Field Mouse.

In Colorado this small field mouse is largely an inhabitant of the boreal zones and is common far above timberline on some of the mountain ranges. It is especially numerous in the high mountain parks of the northern two-thirds of the State, in dry, grassy sagebrush country. It does not appear to enter the surrounding forests to any extent, but occasionally may be taken along streams and in mountain meadows. I found several large colonies on the Front Range just south of James Peak, at an elevation of 12,500 feet, in October, 1906. An interminable labyrinth of runways extended through the moss in copses of an alpine willow (*Salix glaucops*), and many of the field mice could be seen darting from cover to cover. This species was very abundant in the spruce belt on Mount Kelso, at about 11,000 feet, and in places the mossy slope was almost honeycombed by the burrows. It was impossible to catch pocket gophers (*Thomomys fossor*) on Mount Kelso because of these mice, which used the gopher tunnels and were continually getting into the traps.

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[1] Mammals of Colorado, p. 251, 1906.

[2] Warren (The Mammals of Colorado, p. 100, 1910) states that he has seen a specimen from the Summit House on Pikes Peak, at 14,147 feet.

M. nanus is found as low as 6,000 feet in the meadows along White River, east of Meeker, and also near Coventry, Montrose County. In the last locality it is very abundant in the irrigated alfalfa fields, where it is considered very injurious. In the Hahns Peak region and in the parks on the western slope of the Gore Range these field mice were frequently observed in their runways in the daytime. At Coulter, Middle Park, I often watched them feeding on grass among the willows before the tent in the middle of the forenoon, and they seemed quite oblivious of my presence. On the grassy plains east of Como, South Park, this field mouse was using the abandoned burrows and tunnels of *Thomomys fossor* to a large extent.

Mr. Morris M. Green writes of a colony which he observed at Almont (8,000 feet), Gunnison County, in August, 1909: "There was a small colony of these animals in a little marsh, supporting a luxuriant growth of young cottonwoods, spearmint, and succulent, tender swamp grasses. Their runways in several places had little piles of tender grass stalks, cut to a length of 2 or 3 inches, which the little animals could doubtless manipulate easily in their paws. Two adults and three half-grown young were trapped. One runway led to a ball-shaped nest of dead grass under a dead log. The nest had not been frequented lately, and was doubtless a winter abode."

There are specimens from other localities as follows: Arrowhead, Mount Whiteley, Arapahoe Pass, Rabbit Ear Mountains, Estes Park, Cochetopa Pass, and Ruby Lake. Bailey records the species from Twin River and Twin Lakes.[1] Specimens taken by Warren at Crested Butte and Irwin, Gunnison County, have been identified by the Biological Survey.

Microtus (Lagurus) pauperrimus (Cooper). Pygmy Field Mouse.

In July, 1905, while traveling across the sage plains of eastern North Park, I detected evidences of a small species of *Microtus* (presumably a *Lagurus*) and later secured three specimens in the sand hills at the west base of the Medicine Bow Range, east of Walden.

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[1] N. Am. Fauna, No. 17, p. 31, 1900.

In 1906 an adult female was secured at the same locality; six specimens were collected at Elk Springs, 8 miles south of Lily, Routt County; eight were taken near Toponas, in Egeria Park; and the bleached anterior part of a skull was found in the nest of a wood rat near Douglas Spring, at the north base of the Escalante Hills. The above specimens compared with typical *M. pauperrimus* from northeastern Oregon show no differences.

This small, gray, short-tailed field mouse appears to have a somewhat interrupted distribution in northwestern Colorado. (See fig. 16.) Although much of western Routt County consists of sandy sagebrush country, well suited to the species, it was found in but two localities. In the sand hills east of Walden, North Park, the runways of these field mice were beneath the prostrate lowest branches of large clumps of *Chrysothamnus*, and that this is the chief food plant was attested by the many neat little piles of the smaller stems and leaves, cut into short lengths, here and there along the runways. At Elk Springs, on the watershed between Bear and White Rivers, a large colony occupied the grassy swale in which the springs are located, and extended for a considerable distance into the surrounding sandy sage plain. This colony probably numbered many hundreds, and the numerous runways ramifying in all directions formed a perfect network. The small colony near Toponas was located on the sage plain at the west base of the Gore Range, at an altitude of 8,000 feet, and was apparently subsisting largely upon range grasses. The members of this colony were very active during the early evening hours. In less than ten minutes, just after sunset one frosty October evening, three entered traps within a few feet of where I stood. Warren has taken this species at Hot Sulphur, in Middle Park. It has probably reached the open sage parks of Grand County from North Park, as the Gore Range would seem to be an effectual barrier on the west.

Allen has recorded this mouse from Kinney ranch, Sweetwater County, Wyoming,[1] which locality is within 30 miles of the Colorado boundary.

Fiber zibethicus osoyoosensis Lord. Rocky Mountain Muskrat.

Muskrats are reported in most of the streams of central and western Colorado below 9,000 feet, but I have found them common only in the marshes and lakes of the intermountain parks. In the chain of bogs and sloughs in the low meadows along Tomichi Creek, between Gunnison and Parlin, in October, 1907, muskrats were living in tule houses, and the many open trails ramifying through the moss and other vegetation on the surface of the ponds were evidence of their abundance. Muskrats were abundant in the San Luis Valley, especially in the San Luis Lakes. They were common in marshes along Grand River, in Middle Park, where I collected three specimens; two were taken near Hebron on the upper waters of the Platte, in North Park; and two more in a small tributary of the San Miguel River, near Coventry. Other specimens in the Biological Survey collection are from Tevebaugh's ranch, near Cochetopa Pass, secured by Loring in 1892.

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[1] Bull. Am. Mus. Nat. Hist., VIII, p. 248, 1896.

Fiber zibethicus cinnamominus Hollister. Great Plains Muskrat.

The muskrats of the eastern Colorado plains are referable to the pale reddish plains form *F. z. cinnamominus*, recently described from Kansas.[1] They are smaller and paler and have smaller skulls and teeth than the mountain form of central and western Colorado, *F. z. osoyoosensis*. Specimens from the eastern foothills are considered by Hollister to be *cinnamominus;*[2] others from Middle and North Park localities he refers to *osoyoosensis*.[3] I have no records of muskrats above 9,500 feet, and thus the high front ranges appear to be an effective barrier between the two forms in Colorado.

On the plains scores of muskrat houses may often be seen on a single marsh or lake. This is especially noticeable at Barr and other points in the lake region northeast of Denver. Although muskrats are present in most of the streams on the plains, their numbers are small compared with those inhabiting lakes and marshes. They are very troublesome in irrigated sections, as they are continually burrowing in the banks of ditches and reservoirs, often causing serious leaks.

This form is represented in the Biological Survey collection by specimens which I secured at Wray, Yuma County, and a female which contained eight small fetuses, taken by Loring in a small snow-fed lake at 9,500 feet, near Ward, Boulder County, June 8, 1893.

Castor canadensis frondator Mearns. Broad-tailed Beaver.

The identity of the Colorado beaver can not at present be determined, as no satisfactory specimens are available for study. Probably the beaver of the southern and western parts of the State is *frondator*, but those from the higher mountains in northern Colorado may prove referable to *canadensis*. Skulls from Lake Moraine and Crested Butte, sent to the Biological Survey for identification by Warren, are referred to *frondator*.

Very few beavers remain in the streams of the eastern plains region, where they were abundant in early times. Mr. A. E. Beardsley reports a few in the Platte River, 20 miles east of Greeley, according to Warren.[4] Throughout the mountainous parts of the State they are holding their own very well and in many sections appear to be increasing. This is due far more to the protection afforded them by ranchmen than to protective laws, which are often disregarded by trappers in the unsettled sections.

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[1] Proc. Biol. Soc. Wash., XXIII, pp. 125-126, Sept. 2, 1910.

[2] N. Am. Fauna No. 32, p. 31, 1911.

[3] Ibid., p. 26, 1911.

[4] Mammals of Colorado, p. 244, 1906.

In 1905 and 1906 beavers were reported in fair numbers on the headwaters of the Laramie River, the streams of Middle and North Parks, and on the upper Snake, Bear, and White Rivers and their affluents. They were said to be common also in the Ladore Canyon of Green River and in the Yampa Canyon of Bear River, many being trapped each winter. At Blanchard's ranch, 5 miles west of Boulder, in June, 1905, I found an aspen sapling freshly cut by a beaver, but was told that very few of the animals remained on Middle Boulder Creek. A thriving colony is located on Beaver Creek, a few miles above its junction with the South Boulder. When I visited this colony in October, 1906, it was being carefully protected by ranchmen. It extended along the creek for several miles, and all the dams were in good repair. A great many holes were discovered under the banks, and the majority appeared to be inhabited. Only one beaver lodge of recent construction was observed, and two or three dilapidated structures were in neighboring ponds. It was evident that the members of this colony were largely bank beavers.

In 1907 a few beavers were reported in the Cucharas River, a mile or two east of La Veta, and others in the same stream 4 miles south of La Veta. They were said to have formerly been abundant. Forest Ranger E. E. Chapson says a colony of four or five are living in the San Juan River on his ranch, 12 miles northeast of Pagosa Springs, but that beavers are uncommon on the upper waters of the San Juan. They have always been scarce in the streams heading on the western slopes of the La Plata Mountains, according to Mr. Steve Elkins, of Mancos, but were more common in some of the deep box canyons along the Dolores River, south of Paradox Valley. A few are still found on the lower Dolores, although a great many have been caught during the past 5 or 10 years. Along the Los Pinos, from Vallecito down nearly to Ignacio, beavers were reported as quite common, but I did not get an opportunity to examine any of their colonies, two or three of which are said to be located within a few miles of Bayfield. The beavers on this stream are trapped to a considerable extent despite protective laws. Mr. E. G. Bates, of Bayfield, considers them a nuisance in the lower Los Pinos Valley, as they are continually throwing dams across the large irrigation ditches, thus flooding much land and preventing the proper utilization of the water.

In 1892 Loring found beaver signs on Sangre de Cristo Creek, Costilla County, but reported that none of the animals were left in the vicinity of Fort Garland. In 1893 he found a large colony of beavers on Fall River, in Estes Park, counting 10 dams in a distance of 2 miles. Bailey reported a protected colony on the Alamosa River in 1904, and saw beaver work in the canyon of Conejos River, west of Antonito.

Allen reported beavers common in 1871 on the South Plàtte and its tributaries, in Park County,[1] and again in 1892 on the Florida, Animas, Mancos, and San Juan Rivers of southwestern Colorado.[2] In 1895 a colony of 8 or 10 beavers was living in a tule marsh within a stone's throw of the Union Station at Pueblo.[3] The Fur Trade Review (p. 242, 1901) quotes the Denver Times as stating that D. D. Finch, a ranchman living near Trinidad, found it necessary to apply to the State game commissioner for a permit to kill a number of beavers which had established themselves in the creek on his ranch. It is stated that the beavers cut down many of his fruit trees and dammed the creek so that it flooded the first floor of his house. Warren mentions a colony in Grand River, below Grand Junction,[4] and writes that in 1909, while passing through Hardscrabble Canyon, in the Wet Mountains, he saw considerable beaver work.

The habits of the beaver are too well known to require extended description. The quaking aspen is the tree most used by beavers in the Colorado mountains, both in the construction of dams and for food. The engineering skill in controlling water by means of dams displayed by a large colony of beavers on the Slate River at Crested Butte has been described in an extremely interesting article by Warren.[5] The work of beaver colonies on the Grand and White Rivers has been described by Barber.[6] The results of a close study of the work of a colony of beavers in the South Platte River near Littleton is given by Rockwell in the Denver Post of August 9, 1908.

Geomys lutescens Merriam. Yellow Pocket Gopher.

This interesting pocket gopher, the only representative of the genus in Colorado, has a wide range over the plains of the eastern half of the State. (See fig. 17.) It is very abundant in some sections and uncommon in others, the abundance and scarcity apparently depending largely upon the nature of the soil. It is most abundant in sandy areas, where the soft soil favors tunneling.

This species is the most injurious of the Colorado pocket gophers. It seriously damages the alfalfa crop by eating the roots, while the numerous mounds of earth thrown up by the animals in alfalfa fields and meadows also dull the mowing machine sickles and cause great loss of time to ranchmen during the haying season. At Wray,

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[1] Bull. Essex Inst., VI, p. 56, 1874.

[2] Bull. Am. Mus. Nat. Hist., V, p. 81, 1893.

[3] See Forest and Stream, pp. 43-44, 1895.

[4] Mammals of Colorado, p. 244, 1906.

[5] Proc. Wash. Acad. Sci., pp. 429-438, 1904.

[6] Am. Nat., XI, pp. 371-372, 1877.

Yuma County, this gopher is reported very destructive to orchards planted in sandy soil, as it cuts the roots of a great many young trees and frequently kills even those of large size.

On the western end of the Arkansas Divide, in northern Weld County, and perhaps elsewhere along the eastern base of the foothills, *G. lutescens* occupies considerable territory adjacent to the range of *Thomomys clusius.* Both gophers were taken on the grassy plateau north of the Chimney Cliffs in northwestern Logan County within 2 miles of the Nebraska boundary at 5,100 feet. *Geomys* is prevalent on the Arkansas Divide as far west as Eureka Hill, while *Thomomys* is the gopher found south of Seibert. Over a wide area on the southeastern plains *G. lutescens* occurs with *Cratogeomys castanops.* In the vicinity of Lamar it is abundant in sandy country, while *Cratogeomys* is largely restricted to hard-soil flats. Streator found *lutescens* common in sandy river bottoms at both Pueblo and Limon.

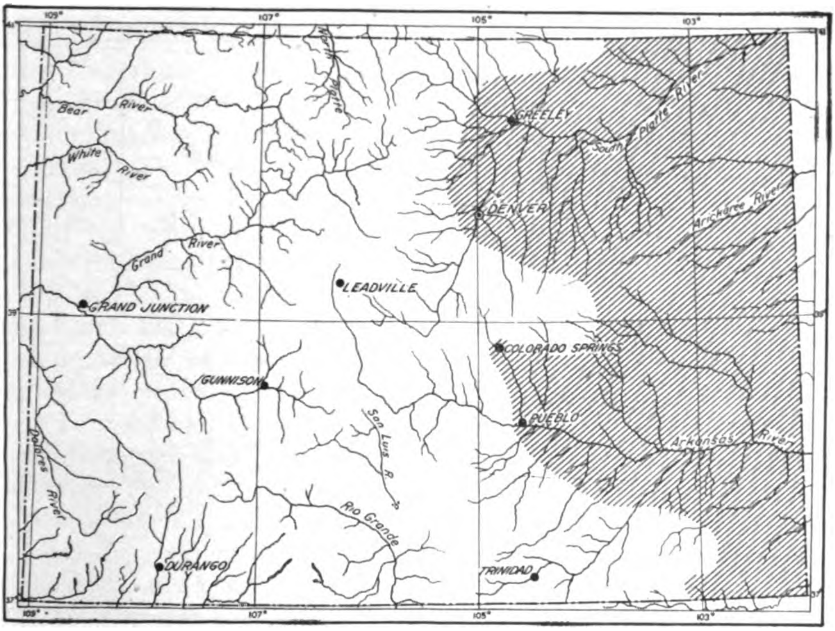

FIG. 17.—Distribution in Colorado of yellow pocket gopher (*Geomys lutescens*).

There are specimens of *G. lutescens* from Loveland, Valmont, Sterling, Avalo, Seibert, Pueblo, Limon, Burlington, Hugo, Kit Carson, Twin Buttes, Chivington, and Las Animas. Other localities represented in the Warren collection are Monon (Baca County) and Colorado Springs. A specimen collected at Denver by Mr. W. D. Hollister has been identified by the Biological Survey.

Cratogeomys castanops (Baird). Chestnut-faced Pocket Gopher.

Pseudostoma castanops Baird, Rept. Stansbury's Exped. to Great Salt Lake, p. 313, 1852. Type from near Bents Fort, Colorado (near present site of Las Animas).

The large chestnut-faced gopher has not been taken much north of the type locality, and the Arkansas Valley marks in a general way the northern limit of its range. (See fig. 18.) Mr. C. E. Aiken, of Colorado Springs, has a mounted specimen taken near the reservoirs several miles north of Lamar, but the species appears not to reach Arlington and Chivington on the line of the Missouri Pacific Railroad. From this latitude (about 38° 15′) the species ranges southward to Chihuahua, Mexico.

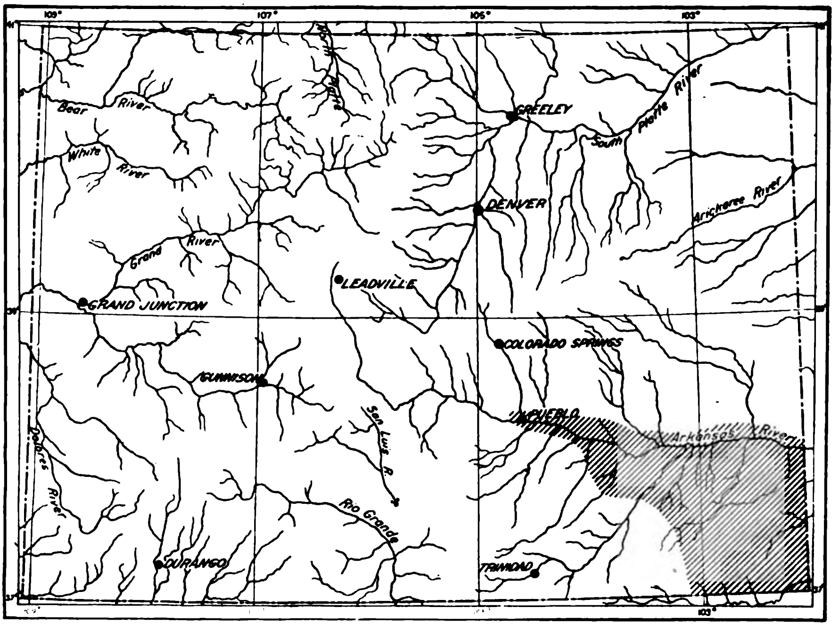

FIG. 18.—Distribution in Colorado of chestnut-faced pocket gopher (*Cratogeomys castanops*).

The type specimen in the United States National Museum was collected on the "prairie road to Bents Fort," which would be near the present site of Las Animas, whence the Biological Survey has a series of topotypes. Other specimens are from Olney and from La Junta (18 miles south). Warren has the species from the following localities: Lamar; Monon, Baca County; Irwin's ranch, Las Animas County; and 3 miles west of Pueblo.

C. castanops may be distinguished at once from the yellow pocket gopher (*Geomys lutescens*), which is found with it over most of southeastern Colorado, by its much larger size and unisulcate upper incisors. It is usually found on hard-soil flats, while *G. lutescens* prefers sandy strips of country and soft soils. The characteristic large flat earth heaps of *Cratogeomys* were seen in abundance on the high plains from Lamar south to Springfield, in Baca County, and thence northwest to Gaume's ranch, in Shell Rock Canyon, and north to Caddoa Station, Bent County. This gopher came under my observation in a cattle and sheep grazing region where there is little land under cultivation and where it is not the pest that it is in agricultural sections.

Thomomys talpoides agrestis Merriam. San Luis Pocket Gopher.

Thomomys talpoides agrestis Merriam, Proc. Biol. Soc. Wash., XXI, p. 144, June 9, 1908. Type from Medano ranch, San Luis Valley, Colorado.

This large pale gopher was found in abundance in the hay meadows bordering Medano Creek at the Medano Springs ranch, near the San Luis Lakes, in October, 1907. The piles of earth thrown up average larger than those of any other species of *Thomomys* found in Colorado, a few being noted fully 4 feet in diameter and a foot high, and they are so numerous as to give a dotted appearance to the closely mown meadows. These large earth heaps prove a great hindrance in harvesting hay, as they clog and dull the mowing machine sickles very rapidly. A white, frosted appearance is presented by many of the gopher hills which have been thrown up by animals tunneling in extensive alkaline deposits, but over most of the meadows the piles are of rich black loam. While most abundant on low ground at Medano ranch, a few gophers inhabit the low, sandy, cactus-covered hummocks which surround the marshes and meadows. I found them very difficult to catch, as they nearly always covered my steel traps with earth and stopped up the tunnels for some distance from the traps.

In traveling northeast from Mosca to the Medano ranch we detected no signs of gophers until we reached the meadow lands southeast of the San Luis Lakes. The characteristic large hills were not seen near Hooper nor in staging from Moffat northwest to Saguache, but were tolerably common in the alkaline soil along the railroad near Moffat and to a point 12 miles north of there. In 1909 Warren secured specimens of *T. agrestis* at Crestone, at the western base of the Sangre de Cristo Range, and others on Mosca Creek. The species thus appears to have a restricted range in the northeastern part of the open San Luis Valley (see fig. 19), but the limits and area of its dispersion are as yet unknown, as are also its food habits. Large sandy areas in the valley appear to be entirely uninhabited by pocket gophers. It is highly interesting to find in the large intermountain San Luis Valley a gopher with relationships nearest *talpoides* of the northern Great Plains. Careful collecting in the Rio Grande Valley of northern New Mexico and on the high mountain barriers on the east and north sides of San Luis Valley make it reasonably certain that *agrestis* is entirely isolated.

The following characterization will serve to distinguish *agrestis* (from original description, l. c.):

"*Characters.*—Size and general characters much as in *talpoides*, but color very different—pale drab as in *ocius* instead of dark brown as in *talpoides;* skull also different.

"*Color.*—Upperparts uniform drab, sometimes with a pale reddish (dull ochraceous) cast on top of head and neck; ear spots conspicuously dusky; underparts soiled whitish, the plumbeous underfur showing through.

"*Cranial characters.*—Skull similar to *talpoides*, but averaging longer and narrower; zygomata less spreading; nasals less regular, less truncate posteriorly, less straight on outer side—tending to spread outward on posterior third; premaxillæ longer and broader posteriorly; maxillary root of zygomata longer and broader and swollen to articulation with jugal so that the jugal part of arch is abruptly and conspicuously narrower; bullæ slightly more swollen.

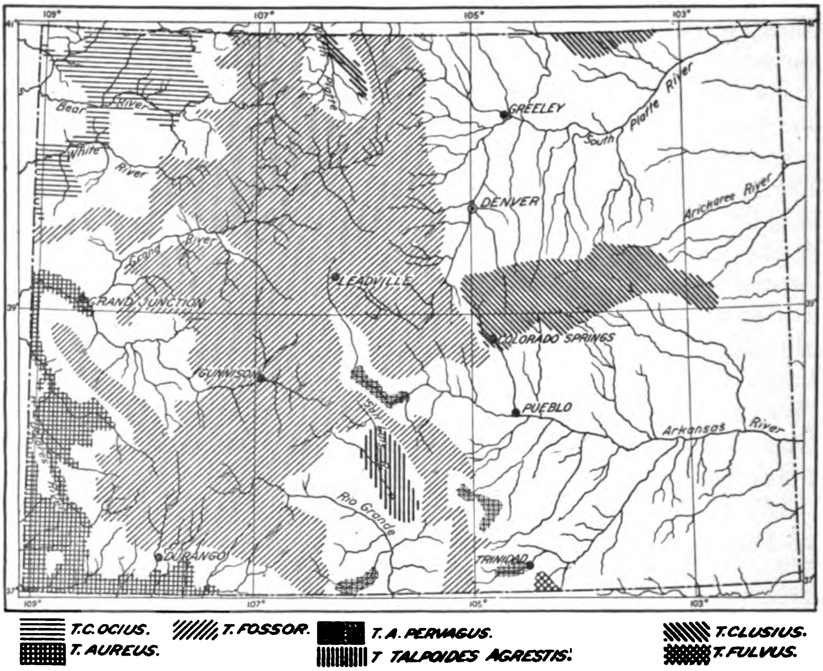

FIG. 19.—Distribution in Colorado of pocket gophers (genus *Thomomys*).

"*Measurements.*—Type: Total length, 220; tail vertebræ, 57; hind foot, 30. Average of 4 females from type locality: Total length, 212; tail vertebræ, 55; hind foot, 29."

Thomomys clusius Coues. Coues Pocket Gopher.

This species extends into North Park from the north, and east of the mountains is common on the high plains of northeastern Weld and northwestern Logan Counties. Toward the south it is again common on the higher western end of the Arkansas Divide, from a point 8 miles south of Seibert west to the base of the mountains near Colorado Springs. (See fig. 19.) The distribution on the plains between the Arkansas Divide and northeastern Weld County is unknown, there being no specimens from the intervening region. Specimens from the lower foothills of Jefferson, Boulder, and Larimer Counties are apparently intermediate in some respects between *T. clusius* and *fossor* of the higher mountains, which indicates a probable continuity of range on the plains at the eastern base of the foothills from the Wyoming boundary south to the Arkansas Divide. Throughout its range *T. clusius* is mainly an inhabitant of high plains and open foothill country in the Transition zone.

This gopher was found sparingly in the sand hills east of Canadian Creek, North Park, at the west base of the Medicine Bow Mountains. In July it was feeding largely upon a species of lupine (*Lupinus alpestris?*), and large caches of the stems and leaves of this plant were found in some of the burrows. North Park specimens accord well with typical *clusius* from Bridgers Pass, Wyoming. This gopher is apparently rare in North Park, since it was found at no other point.

The Coues gopher is the dominant species on the high plains of northeastern Weld and northwestern Logan Counties. At Chimney Canyon, some 30 miles northwest of Sterling, where I collected five specimens on the grassy plateau which forms the summit of the Chimney Cliffs, at 5,100 feet elevation, *Geomys* also was sparingly present. *Thomomys* was the only gopher found at Pawnee Buttes, some 30 miles southwest of Chimney Canyon, and thence westward and northward to the Wyoming boundary north of Grover. It is probably the dominant gopher over all the high grassy watershed between Horsetail and Lodge Pole Creeks, including a small area in extreme western Nebraska.

On the Arkansas Divide the eastern limit of its range appears to be 8 miles south of Seibert, where a specimen was taken from a small colony in hard soil on the north slope, at about 4,500 feet. From this point the species has a continuous range westward on this high watershed to the base of the foothills. Streator found it abundant at Limon and Flagler, and Warren states that it is tolerably common on the plains at Colorado Springs, occurring there with *Geomys lutescens*.[1]

Thomomys clusius ocius Merriam. Green River Pocket Gopher.

On the sage plains of western Routt and Rio Blanco Counties this pale grayish form is the only pocket gopher present. It is abundant in the lower valleys of the Snake, Bear, and White Rivers, and in Browns Park, on Green River. On the watersheds between these valleys, however, it occurs only in scattered colonies, usually in sandy strips of country. At no point was this gopher found much above 6,000 feet. Baggs Crossing appears to be the eastern limit of its range in the Snake River Valley, while the boreal-capped escarpment of the Book Plateau forms an effective barrier to its southward dispersion. (See fig. 19.) In all the high mountainous country on the south and east of its range *T. ocius* is replaced by *T. fossor*. The ranges of the two do not appear to meet, however, and there is a region of varying width in which no gophers were found.

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[1] Mammals of Colorado, p. 252, 1906.

Gopher hills were abundant on the divide southwest of Rangely, and a few were seen near the Utah boundary in the valleys of Texas and Evacuation Creeks. A specimen taken on Bear River, south of Lay, August 8, and another from Snake River (15 miles northeast of Sunny Peak), August 24, are in short reddish summer pelage. September specimens from Ladore, Lily, Elk Springs (8 miles south of Lily), and Rangely are in the full grayish winter coat. The anterior part of a bleached skull was found in a wood-rat nest at Douglas Spring, at the north base of the Escalante Hills.

In the river valleys, where *ocius* is most abundant, ranchmen do not consider it very injurious, since it prefers sandy and waste soil and greasewood flats to meadow land and alfalfa fields.

Thomomys fossor Allen. Colorado Pocket Gopher.

Thomomys fossor Allen, Bull. Am. Mus. Nat. Hist., V, p. 51, 1893. Type from Florida, La Plata County, Colorado.

The general distribution of this dark-brown, medium-sized species in the Colorado mountains is indicated by specimens from a wide range of localities. It is the only gopher found in the higher mountains and occurs regularly from 7,000 feet to 13,000 feet, both in heavy forests and on the open slopes far above timberline. It is common as low as 7,000 feet in the yellow pine forests of Archuleta, La Plata, and other southwestern counties, but at few points does it range much below the Canadian zone. (See fig. 19.) The greatest numbers are found in the aspen belt of the Canadian zone, where the numerous fresh hills of earth thrown out each night attest to the great activity of the animals in the rich black soil. (See fig. 20.) The lower limits of range are roughly indicated by Florida, Pagosa Springs, Sapinero, Hayden, Meeker, Elkhorn (Larimer County), and foothills near Boulder and Golden. Gophers from the lower eastern foothills of the Front and Medicine Bow Ranges are not typical, and they show an approach toward *clusius* of the higher plains.

Ranchmen in the foothill valleys and mountain parks suffer considerable loss through the depredations of these animals, and every year a large acreage of alfalfa is killed by gophers cutting the roots just beneath the surface of the ground. In the spring of 1905 Mrs.

Blanchard, living 5 miles west of Boulder, discovered, 3 inches below the surface, a cavity in which a gopher had a store of nearly 50 tiger-lily bulbs, evidently gathered the previous fall. The cavity was nearly full and the bulbs were scattered through loose earth, which had been thoroughly worked over. A tunnel led directly from the cache to the flower bed a rod or so distant. Near Golden this gopher is said to make itself a nuisance by burrowing in the banks of irrigation ditches and reservoirs, and this is probably true in other sections along the lower edge of its range. The numerous hills of earth and stones thrown up in hay meadows and grain fields dull the sickles of mowing and harvesting machines.

As an offset to the injury inflicted upon agricultural interests along the lower edge of its range, *T. fossor* is an important agent in the conservation of forests and moisture in the higher mountains, where it is most abundant. The thorough and continual working and enriching which the soil receives through the activities of gophers is highly beneficial to forest growth, and at the same time a large amount of moisture which would otherwise run off the mountain slopes is retained in the numerous burrows and underground tunnels which might properly be termed natural water traps.

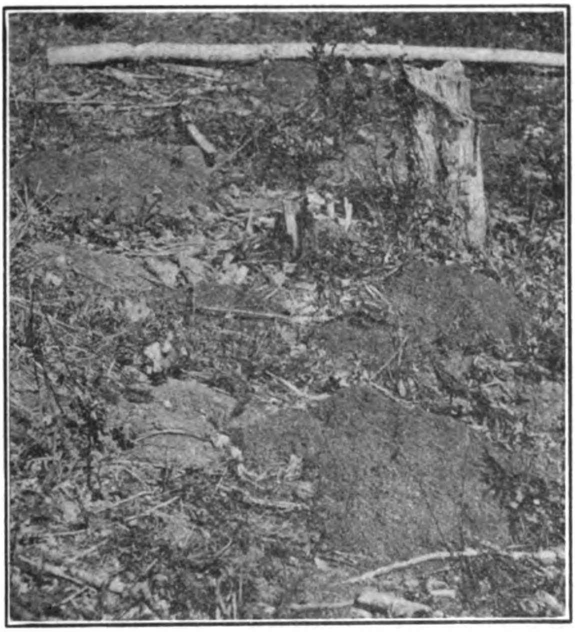

FIG. 20.—Earth heaps of Colorado pocket gopher (*Thomomys fossor*) on Book Plateau, at 8,000 feet.

On the higher open mountain slopes, particularly above timberline, one often sees peculiar long serpentine ridges of earth, sometimes dry and hard packed, but more often partially disintegrated through the action of moisture. These are formed by gophers during the winter when snow covers the ground to a considerable depth. The loose earth thrown out is packed into the ramifying tunnels which the animal has made through the snow on the surface of the ground.

Thomomys fulvus (Woodhouse). Fulvous Pocket Gopher.

A female from Fisher Peak, southeast of Trinidad, is referable to this species. It was collected September 15, 1903, at an elevation of 8,000 feet, by Mr. A. H. Howell, who states that gophers were tolerably common in the parks on the upper slopes of Fisher Peak, in the Transition zone. This gopher probably reaches Colorado only in the Trinidad region (see fig. 19), although it has been taken at a number of points in the foothills of northern New Mexico just south of the Colorado line.

Thomomys aureus Allen. Golden Pocket Gopher.

The golden pocket gopher is found in the low valleys of southwestern Colorado from the lower Grand River Valley southward in the Upper Sonoran zone. In a general way it occupies the valleys and lower flats south and west of the San Juan and La Plata Mountains and the Uncompahgre Plateau (see fig. 19), but as it has been taken at Grand Junction, it may cover a considerable area in the lower Gunnison Valley. In 1907, however, I saw no signs of pocket gophers at any point in either the Gunnison or Uncompahgre Valley. Gophers seem to be absent or very scarce in the Grand Valley also, as in following along Grand River from the Utah line to Rifle, a distance of 100 miles, I neither saw nor heard of any.

There are in the Biological Survey collection specimens of *T. aureus* from Arboles; Bayfield; Mesa Verde, northern end, 8,100 feet; Ashbaugh's ranch, near McElmo; Coventry; and Grand Junction. The Grand Junction specimen, taken November 7, 1895, by Mr. A. H. Howell, is an adult female in beautiful golden gray winter pelage. The others from Colorado are all June and July specimens, a June male from Arboles being darker than typical *aureus*.

At Bayfield, Ashbaugh's ranch, and Coventry these gophers are abundant, and are reported to be very injurious in grain and alfalfa fields. They are stated to be very destructive also to young orchards near Bayfield, as they cut off the roots of the trees. They reach their upper limit along the Los Pinos in the pinyon country near Bayfield at 6,500 feet, all the yellow pine belt north of that point being occupied by *T. fossor*. Along the San Juan River they are found as far east as Arboles, where they are common in sandy soil along the railroad track. In the Coventry region these gophers are very numerous on the cultivated flats between the San Miguel River and Naturita Creek, extending up to about 6,500 feet. They are a great nuisance in this irrigated section, tunneling in the banks of ditches and reservoirs and causing numerous and often serious leaks. In the arid desert region along the lower San Miguel and Dolores Rivers gophers are very scarce, the only signs noted being at the Dolores River crossing in Paradox Valley and at Uranium in Sinbad

Valley, and these workings were not fresh. They are a pest at Ashbaugh's ranch in the valley of McElmo Creek, but apparently do not inhabit the bordering mesas. Many ranchmen keep a number of cats purposely for killing gophers, and a great many of the animals are drowned out when the fields are irrigated. Mr. George J. Ashbaugh attributes to pocket gophers the holes which he occasionally finds eaten into watermelons from beneath.

Gopher mounds were abundant on the northern end of Mesa Verde, between 7,500 and 8,100 feet, in the Transition zone, and a specimen collected June 14 at 8,100 feet is referred to *aureus*. This seems to be the only Colorado record for this species in the Transition zone. The workings were in soft soil, either among sagebrush or in the small grassy parks scattered here and there among the dense chaparral of oak and June berry. No signs of gophers were found among the pinyons on the southern end of Mesa Verde below 7,500 feet. Gopher hills seen in alfalfa fields just west of Mancos, and also in the bottom of the Dolores Canyon, 2 miles east of Dolores, were the characteristic large earth mounds of *aureus*.

Thomomys aureus pervagus Merriam. Espanola Pocket Gopher.

This large species is the most richly colored of the Colorado pocket gophers. It was described from Espanola, Santa Fe County, N. Mex., and is known to range north as far as Salida, in the lower end of the upper Arkansas Valley. The distribution between these two points has not been worked out in detail, but specimens from the Huerfano Valley at Gardner and from Antonito and the Conejos River Canyon, 10 miles west of Antonito, indicate a range in the foothill valleys along the east sides of both the Sangre de Cristo and San Juan Ranges, chiefly in the Upper Sonoran zone. (See fig. 19.)

It is impossible to state from present knowledge how this species has reached the upper Arkansas Valley, or whether, indeed, continuity of range exists. It is reasonably certain, however, that it does not cross the 9,000-foot Poncha Pass from the San Luis Valley, as the Poncha Pass region, which is practically in the Canadian zone, is occupied by *T. fossor*. The characteristic large hills of *T. pervagus* were seen in abundance on the sandy flats in widenings of the Arkansas Canyon from Salida down to Texas Creek Station; but the Grand Canyon of the Arkansas, beginning a few miles below Texas Creek and culminating in the stupendous chasm of the Royal Gorge, must certainly separate *pervagus* from the gophers inhabiting the Upper Sonoran country around Canon City, at the lower end of the canyon. It remains to determine the species occurring in the Arkansas Valley near Canon City, and thence south along the eastern base of the Wet Mountains, but logically it should be *pervagus*, as this is the gopher abundant in the Huerfano Valley from Badito west to Gardner.

Apparently, also, this is the form whose large hills were so common in the Cucharas Valley from Walsenburg up to La Veta, and between Trinidad and Weston in the upper Las Animas Valley. In going from Texas Creek to Westcliffe and thence overland south to Gardner, the small hills of *fossor* were the only signs of gophers noted, and these were found chiefly in the high Wet Mountain Valley. Over a wide strip of mixed yellow pine and pinyon country south of the Arkansas River at Texas Creek, and also on the southern slopes of the divide connecting the Wet Mountains with the Sangre de Cristo Range, no gophers appear to be present.

In the San Luis Valley, *T. pervagus* is known only about its southern end. Just how far north it extends along the eastern base of the San Juan Range is not known. The large gopher hills which Bailey found abundant along the Rio Grande at Del Norte may have been either *pervagus* or the pale *T. agrestis* described from Medano Springs ranch, near the San Luis Lakes, the range of which also is very imperfectly known. I saw no gopher work near Saguache.

Throughout its range *T. pervagus* revels in the rich mellow soil of the stream valleys, or occupies the sand flats along the lower bordering slopes, as in the Arkansas Valley above Salida. In the Cucharas, Huerfano, and Las Animas Valleys these gophers frequent alfalfa fields, throwing out the rich brown or reddish soil in large hills, often 3 feet or more in diameter, which must prove a great hindrance in harvesting the crop, aside from the serious injury which the animals inflict upon the alfalfa itself by eating the roots, of which they are very fond.

The Salida specimens were collected at Sand Park, the sandy eastern slope of the Arkansas Valley a mile north of the town. The gopher hills were common in this strip of country, both along the embankments of the Denver & Rio Grande Railroad near the river, at a little over 7,000 feet, and up to the lower edge of the pinyons 400 or 500 feet higher, but they were not noted in the adjoining adobe soil. They were usually thrown up among the bunches of prickly pear (*Opuntia polyacantha*) or beneath *Chrysothamnus* and *Atriplex* bushes. One of these shrubs at least, *Atriplex canescens*, forms a part of the animal's food, as in one of the underground tunnels was a cache of its stems and leaves.

Specimens from Salida and Gardner, taken in early November, are in beautiful full reddish-brown winter pelage, with a considerable coal black area on chin, lips, and throat. An immature Gardner specimen has the sides of the throat strongly suffused with reddish-orange, and this suffusion is more or less indicated in all the adults.

Perodipus montanus (Baird). San Luis Kangaroo Rat.

Dipodomys montanus Baird, Proc. Acad. Nat. Sci. Phila., VII, p. 334, 1855.
Type from old Fort Massachusetts (near Garland), Colorado.

This peculiar Upper Sonoran mammal inhabits the sandy areas in the San Luis Valley (see fig. 21), and thence extends south into the high valleys and parks of northern New Mexico. It is one of the highest ranging species of the genus, in the San Luis Valley occurring up to 7,900 feet and possibly a little higher, and throughout its range it is restricted to the mountain valleys. The type of *montanus*, in the National Museum, was collected in 1853 by F. Kreuzfeldt, on Capt. Beckwith's expedition. In addition to a large series of topotypes from Fort Garland, the Biological Survey has specimens from Antonito; Conejos River, 10 miles west of Antonito; and Medano Springs ranch, near the San Luis Lakes. Warren has taken the species at Crestone.

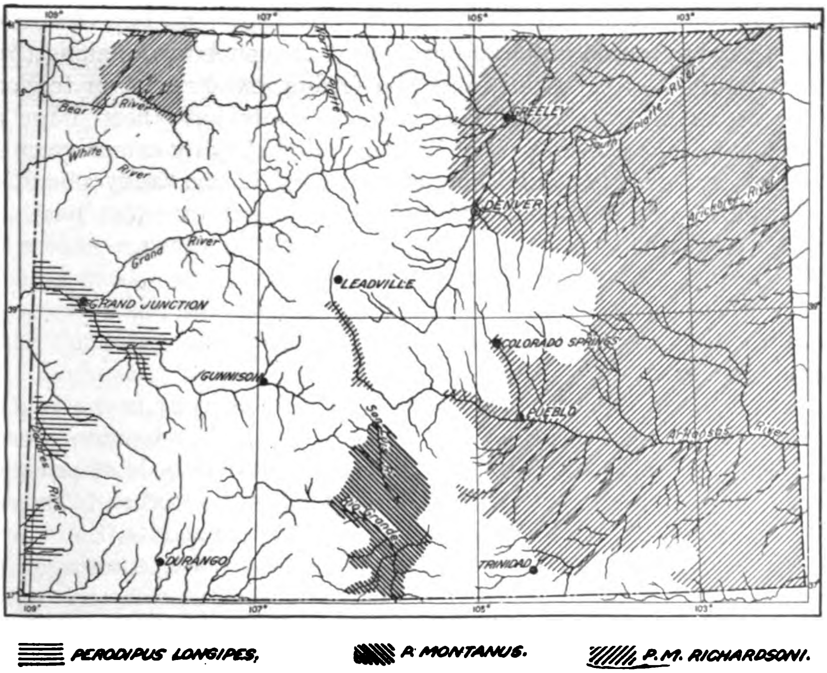

FIG. 21.—Distribution in Colorado of kangaroo rats (genus *Perodipus*).

The characteristic burrows are tolerably common along the railroad at Moffat, and thence northwest to a point 6 miles southeast of Saguache, and kangaroo rats are said to be occasionally plowed out in the fields at Saguache. In going north from Moffat the burrows were often noted in the gravelly soil along the railroad near the hot springs, but the only signs of kangaroo rats seen farther north were two fresh burrows in sandy soil a mile south of Villa Grove, at an elevation of 7,900 feet—a point doubtless very near the northern limit of the species. The high Poncha Pass country effectually separates *montanus* from *P. richardsoni* of the upper Arkansas Valley.

At Fort Garland Loring found this species abundant in a cultivated field, but absent from the sagebrush country. Bailey reported it very common in the Rio Grande Valley at Alamosa and Del Norte and in the Conejos River Canyon. A specimen taken on Conejos River had its cheek pouches filled with the heads of gramma grass. Del Norte is apparently very near the western limit of *montanus* along the Rio Grande, as I saw no signs above that point.

Kangaroo rats are stated to have been very numerous at Mosca some years ago when only small areas were under cultivation. At that time they were very injurious to crops, digging up large quantities of newly planted grain and caching it in their burrows along the sandy margins of the fields, and also feeding extensively on tender green stems of wheat. Of late years the rats have been largely driven out of the central part of the San Luis Valley by extensive cultivation and irrigation, and now are gathered in the sandy uncultivated parts, particularly in the sandhills along the western base of the Sangre de Cristo Range from Garland north to Crestone. According to cowboys they are so numerous in the Luis Maria Baca grant, south of Crestone, that their burrows and tunnels completely undermine the sandy ground in many places and make riding difficult and even dangerous.

At the Medano ranch kangaroo rats were found chiefly in the sandy hummocks just southeast of the headquarters. The burrows were usually beneath *Sarcobatus* or *Atriplex* bushes, or in beds of prickly pear (*Opuntia*), and more rarely under the large rabbit brush (*Chrysothamnus patens*). As with other species of kangaroo rats, there are usually from three to six entrances to a nest, each entering the ground at an angle of less than 45 degrees, sometimes nearly horizontally, and usually from different directions. Kangaroo rats are nocturnal as a rule, but I caught one individual in a trap during the daytime at the Medano ranch, and early one morning before sunrise saw another dart into its burrow, leaving a tiny cloud of dust behind.

Perodipus montanus richardsoni (Allen). Richardson Kangaroo Rat.

This interesting species is represented by a large series of specimens, chiefly from east of the mountains on the plains, where it is generally distributed. It occurs also over parts of the sandy sage plains of northwestern Colorado, in Routt County, reaching that region from the Wyoming plains on the north. (See fig. 21.) It follows some of the warm Upper Sonoran valleys into the eastern foothills of the front ranges, the upper limits being indicated by Arkins, Larimer County; Twin Lakes; Salida; 8 miles west of Gardner, Huerfano County; and La Veta.

In northwestern Colorado kangaroo rats occur sparingly in the sandy bottoms along Bear River south of Lay; and also near the Wyoming boundary, a few miles southwest of Baggs Crossing. In the lower valley of Snake River and throughout the sandy sage plains north of Bear River they were found in abundance. At no point were they noted much above 6,000 feet. The greatest numbers were found on the east side of Snake River, near Sunny Peak. Here a large colony occupied a sandy strip of country abounding in blow-outs, and the burrows were either in the banks of these or beneath bushes of *Atriplex confertifolia* or *Grayia spinosa*. Specimens from northwestern Colorado are referable to *P. richardsoni*, although they average a little smaller than the typical form and have weaker maxillary arches—in these two respects approaching *P. montanus* of the San Luis Valley.

During a trip from Cheyenne Wells northwest across the plains to Sterling and Grover I found kangaroo rats generally distributed in all sections having sandy and soft soils. Our night camp, June 2, some 20 miles northwest of Sterling, was near an old sod corral, the sides of which had tumbled down and partially disintegrated. The soil here was soft and easily excavated and had attracted hundreds of kangaroo rats, whose burrows fairly honeycombed the ground. A small number of traps put out here secured 12 specimens.

Kangaroo rats are abundant at Gardner, in the Huerfano Valley, both on sandy flats along the river and on the low adjoining benches. The burrows at this point were usually beneath chico brush (*Atriplex canescens*), and after a 2-inch snowfall during the night of November 18 I saw the peculiar round tracks made by a few which had come out of their burrows during the night and skipped about on the fresh snow. The leaps taken when running are long, often 3 or 4 feet. Kangaroo rats are reported along Muddy Creek, 8 miles west of Gardner. In the Cucharas Valley they are common at Walsenburg, and a very few burrows were found at La Veta.

In November, 1907, I found kangaroo rats exceedingly numerous on the gently inclined sandy slopes lying along the east side of the Arkansas River, just north of Salida; and I saw from the train near Howard and Cotopaxi, farther down the river, burrows which I attributed to this species. Mr. J. W. Frey states that the rats are found north to Browns Canyon, 7 miles above Salida, and west to Poncha Springs. Kangaroo rats were most abundant at Salida among the *Chrysothamnus* bushes, Russian thistles, and in beds of *Opuntia polyacantha*, on the upper sand slopes just below the edge of the pinyons, between 7,100 and 7,400 feet. The Salida series is not typical *P. richardsoni*, but is much nearer to that species than to *montanus* of the San Luis Valley. A Twin Lakes specimen recorded by Coues and Yarrow[1] as "*Dipodomys phillipsi ordi*" was collected by Dr. J. T. Rothrock in August, 1873, and if correctly labeled is an important record because of the high elevation. The Royal Gorge, and in fact much of the Grand Canyon of the Arkansas, would seem to prevent continuity of range from the plains; but it is evident that the kangaroo rats of the upper Arkansas Valley reached that region by way of the Arkansas drainage area, apart from all physiographic considerations, since their relationship is clearly with *richardsoni*.

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[1] Expl. W. of 100th Mer., V, p. 109, 1875.

The typical home of the kangaroo rat is in sandy river bottoms or on the numerous sand ridges scattered here and there over the plains. It is seldom found living in hard soils, but often takes up its abode in cultivated fields. The more or less horizontal burrows are excavated beneath bunches of prickly pear, yucca, and sagebrush, or in the banks of blow-outs and railroad embankments. The animals are nocturnal and most active during the latter part of the night. During the day the burrows are often closed from within, but early in the morning they are usually found open, with a quantity of freshly ejected sand at the entrances. Their food consists of various seeds, and the stems of grass and wheat are often found in the capacious external cheek pouches. The pouches of a specimen collected at Salida early in November contained about equal quantities of the leaves of *Atriplex canescens* and the seeds of a species of *Chrysothamnus*.

Perodipus longipes (Merriam). Moki Kangaroo Rat.

Kangaroo rats from Fruita, Grand Junction, Hotchkiss, and Ashbaugh's ranch (McElmo Valley), show no departure from typical *P. longipes* from the Painted Desert, Arizona. Others from Coventry and Naturita in the San Miguel region, at a somewhat higher elevation, average darker than typical specimens, but, as they accord well in other essentials, are not considered separable.

The Moki kangaroo rat is a creature of the sandy desert areas of the southwest and is normally restricted to the lowest and warmest parts of the Upper Sonoran zone. It reaches Colorado along the Colorado River Valley, the northern limit of range being marked by the Book Cliffs (see fig. 21), which separate it from *P. richardsoni* of the northern plains.

By reason of the extensive cultivation of the lower Grand Valley during recent years, kangaroo rats now occupy less ground than formerly. They are found chiefly in the narrow strip of rough uncultivated country lying at the southern base of the Book Cliffs, and on the desert northwest of Mack. In the arid valley of West Salt Creek, between Mack and Carbonera, the characteristic burrows were often noted in the banks of arroyos and on sand flats. In a large colony on the sandy plain 3 miles northwest of Fruita, the entrances to the burrows were usually in large bunches of prickly pear (*Opuntia*), but were occasionally beneath bushes of *Atriplex confertifolia*. During the time this colony was under my observation, toward the end of September, the animals seemed inactive, and very few piles of fresh earth were noted at the burrows. No signs of kangaroo rats were seen in the Grand Valley above Grand Junction, and they probably do not occur east of Palisade, where the valley narrows into a more or less continuous canyon. They extend southeast in the Gunnison Valley for some distance, apparently reaching their eastern limit near Hotchkiss, on the North Gunnison River, where I collected an immature specimen in August. Burrows were often seen on the arid waste between Rogers Mesa and Delta, but none were noted in the Montrose region.

Kangaroo rats are reported abundant on the lower San Juan River, and they extend as far east as Moqui in the McElmo Valley. In June I found a few burrows on sandy flats along McElmo Creek at Ashbaugh's ranch, midway between Moqui and McElmo, but the animals were inactive here or else the burrows were deserted. Warren has taken the species at Ashbaugh's ranch.

Near Coventry, at 6,800 feet, scattered colonies of kangaroo rats are found in the rather hard clayey soil on the sagebrush flats, and the rats become increasingly numerous toward the west, as the elevation becomes lower, the soil sandy, and the region more desertlike. At Dry Creek, 5 miles west of Naturita, and thence down the East Paradox Valley and across the Dolores River to the head of West Paradox Valley, they are very numerous on the sandy flats and hummocks. On my return trip from the La Sal Mountains through the Sinbad Valley and thence down the Dolores River to the mouth of West Creek, however, no signs of kangaroo rats were seen, although much of the region is suitable for them. North of San Miguel River they are found at Nucla and nearly to Tabeguache Creek.

The burrows of this species average somewhat larger than those of *P. richardsoni*, although the animals themselves are of nearly the same size. The deserted burrows are often used by cottontails (*Sylvilagus a. warreni*) in the lower San Miguel region, and occasionally both animals are found living in the same colony.

Perognathus hispidus paradoxus Merriam. Kansas Pocket Mouse.

This large pocket mouse occurs sparingly on the plains of eastern Colorado, from the base of the foothills in Boulder and Jefferson Counties east and southeast to Baca County, in the extreme southeastern corner of the State. It has been taken at a few widely separated localities over this region in the Upper Sonoran zone.

Specimens were collected at Sterling by Dr. A. K. Fisher, who reports the species as tolerably common at that locality. Another was secured at Hugo by Prof. Lantz, who found it common along

Big Sandy Creek. In the Merriam collection there is a specimen from Boulder County, collected in 1889 by the late Denis Gale, of Gold Hill, at 5,500 feet. The precise locality is not given on the label, but was probably at the base of the foothills not far from Boulder. I noted several of the characteristic auger-hole burrows of this pocket mouse on the lowest foothill slopes a mile southwest of Golden, and found the species common in southern Prowers and Baca Counties. Specimens from Monon, Baca County, are recorded by Warren.[1]

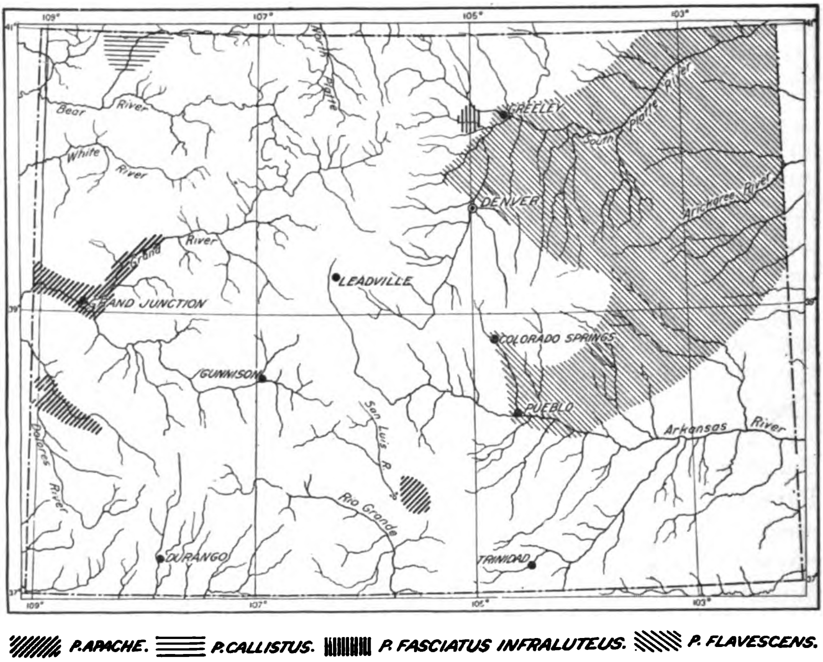

FIG. 22.—Distribution in Colorado of pocket mice (*Perognathus fasciatus* and *P. apache* groups).

Perognathus fasciatus infraluteus Thomas. Buff-bellied Pocket Mouse.

Perognathus infraluteus Thomas, Ann. and Mag. Nat. Hist., ser. 6, XI, p. 406, May, 1893. Type from Loveland, Larimer County, Colorado.

Known only from the type locality, from which place the Biological Survey has a series of 10 specimens, collected in October, 1894, by Mr. Clark P. Streator. The type specimen in the British Museum was taken by Mr. W. G. Smith April 4, 1892. (See fig. 22.)

The Loveland animal appears to be geographically separated from its near relative, *P. fasciatus* of the northern plains, from which it is distinguishable by the strong buffy suffusion on the underparts in marked contrast to the pure white underparts of *P. fasciatus*.

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[1] Mammals of Colorado, p. 253, 1906.

Perognathus flavescens Merriam. Plains Pocket Mouse.

All the records for this pocket mouse are from the plains region north of the Arkansas Valley, where it appears to occur only in sandy strips of country, being most abundant in the northeastern counties. (See fig. 22.) It has not been taken in the southeast, where *P. flavus* replaces it. At Sterling Dr. A. K. Fisher found it common in sunflower patches on sandy soil, and Loring found it at Greeley occupying sandy strips of country with *P. flavus* and living in burrows beneath *Opuntia* and yuccas. Specimens were secured by Streator on the sandy bottoms along the Arkansas River at Pueblo in December, when the animals were gathering their winter's supply of seeds. At Tuttle I trapped a specimen beneath a yucca in a sand blow-out on the north side of the valley of the South Fork of the Republican River. A specimen from Boulder County was found by the late Mr. Denis Gale in the nest of a long-eared owl (*Asio wilsonianus*), at 5,500 feet, May 12, 1890. This record proves that the range of this pocket mouse extends at least to the eastern base of the foothills, and the animal may be found even in some of the warm foothill valleys. Warren has taken specimens at Colorado Springs, but thinks the species is uncommon at that point.

Perognathus flavus Baird. Baird Pocket Mouse.

This beautiful little pocket mouse is common on the Upper Sonoran plains of eastern and southern Colorado between 4,000 and 7,500 feet elevation, the highest altitude being reached in the San Luis Valley. (See fig. 23.) At a number of localities on the northeastern plains it is associated with *P. flavescens*. The burrows of the two species are not readily distinguished, but those of *flavus* average smaller. A large series from eastern plains localities are typical *flavus*, but specimens from Ashbaugh's ranch, Montezuma County, are considerably darker, and approach *P. f. bimaculatus*.

At Antonito and along the Conejos River, Bailey found this species abundant on the sandy sage plains, and I found it inhabiting similar areas at the Medano Springs ranch, near the San Luis Lakes, and also in weed patches and dry meadows. Most of the older gopher hills near the Medano ranch had been tunneled more or less by pocket mice, but I seldom found the burrows inhabited. These tunnels usually entered the soft dirt of the gopher hill from one side, passing horizontally through, and often connected with other horizontal tunnels. One such burrow was inhabited by an immature pocket mouse, which I caught in my hands. The hole reached a depth of 12 inches in the soft earth, ending in a small chamber 1 by 2 inches, in which were stored a few grass seeds. Although pocket mice are usually nocturnal, I caught one in a trap at the Medano ranch in the daytime, and also saw another individual running in the grass near the same burrow at 2 p. m. on a bright day. They appear to be inactive on damp or rainy nights.

At Ashbaugh's ranch two specimens were trapped beneath *Atriplex* bushes on sandy flats. Mr. Ashbaugh thinks this is the little pinkish mouse which does so much damage in the McElmo Valley at corn-planting time by enlarging the hole left by the corn planter and taking out the kernels; and also in the autumn, when it eats much grain beneath the shocks.

Near Greeley Loring found *P. flavus* abundant over a sandy strip of country, living among clumps of yucca and prickly pear. Streator collected a series of specimens in sunflower patches on waste land near Loveland in October, baiting his traps almost exclusively with sunflower seeds, which appeared to be the chief food of these mice at the time. Prof. Lantz found a large store of sunflower seeds in a burrow which he dug out in southeastern Otero County in April, 1910. He observes that the tail of this species is to some extent prehensile. In the case of several which he carried alive in his hand, the tail at times clasped a finger. In Shell Rock Canyon, northwestern Baca County, I usually found the burrows beneath tree cactus (*Opuntia arborescens*) in the sandy bed of the canyon or on the adjoining benches.

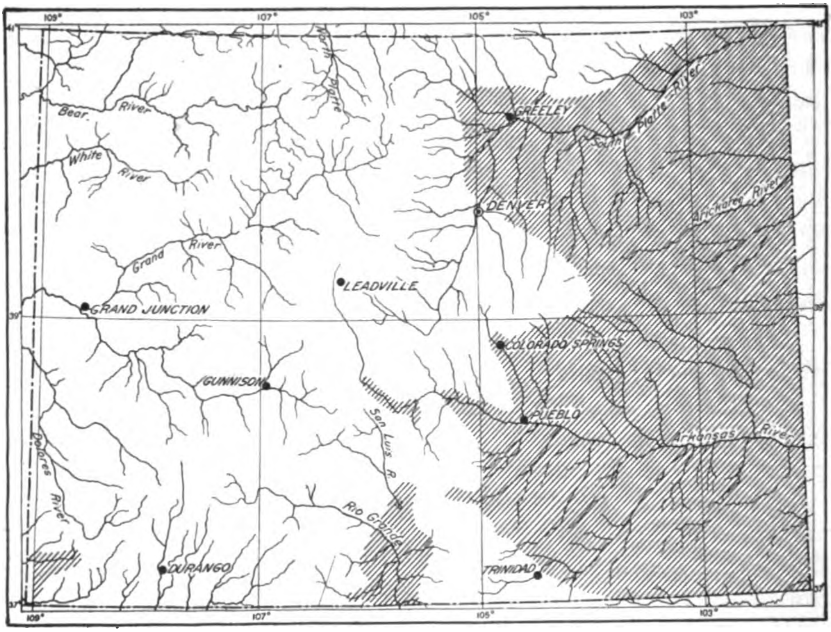

Fig. 23.—Distribution in Colorado of Baird pocket mouse (*Perognathus flavus*).

There are specimens from Burlington, and Streator reported this species at Olney and Flagler. I saw numerous signs of small pocket mice at Gardner and Walsenburg among bunches of prickly pear (*Opuntia polyacantha*) on the sandy benches bordering the Huerfano and Cucharas Valleys. Warren has specimens from Colorado Springs, Lamar, Springfield, and Texas Creek between Rito and Hillside. A specimen in the collection of the Colorado Agricultural College, taken by Mr. S. Arthur Johnson in Spring Canyon, 4 miles southwest of Fort Collins, has been identified by the Biological Survey.

The distribution of *P. flavus* in the upper Arkansas Valley has not been worked out. It may occur in the sand as far up as Buena Vista, since it is common on the sandy slopes just above Salida. This region is doubtless reached by way of the Arkansas drainage area, although the Royal Gorge must prevent continuity of range in the immediate river valley.

Perognathus apache Merriam. Apache Pocket Mouse.

Eight specimens from Rifle, Fruita, Coventry, and Medano Springs ranch (San Luis Valley) are provisionally treated as *P. apache*, although none of them are quite typical. All are darker than typical *P. apache*, in this respect tending toward *P. a. melanotis*. The Coventry specimen in particular is very richly colored, like *melanotis*, but is larger, as are also three specimens from Bedrock, Montrose County, identified for Warren. It is probable that the Coventry and Bedrock specimens could be safely referred to *melanotis*, but, since dark, richly colored specimens are of irregular occurrence throughout the range of *apache*, it seems best to include all Colorado specimens under this species. (See fig. 22.) A specimen from the Grand River Valley near Rifle is very large for *apache*, but is equaled in size by one from Espanola, New Mexico. More material from southern and southwestern Colorado is needed before the status and distribution of the *apache* group of pocket mice within the State can be satisfactorily determined.

Little is known concerning the habits of these handsome, medium-sized pocket mice. In the lower Grand River Valley in 1906 I found them among the prickly pears on the sandy desert north of Fruita, and also on a sandy piece of waste land near Morris, 7 miles west of Rifle. A fair-sized colony was occupying a sandy knoll near Morris, and the many freshly ejected sand piles showed its members to be active. However, when I again visited the locality the following year, I noted very few signs. The distribution in the Grand Valley appears to be very local, as no signs of pocket mice were seen between Fruita and Rifle.

In the region of the lower San Miguel and Dolores Rivers the characteristic burrows of pocket mice were noted on a sandy sage flat near Uranium, in the Sinbad Valley. The extreme abundance of white-footed mice at this point prevented my taking specimens, but the large size of the sand heaps thrown out from the burrows pointed to *apache* rather than to the small *P. flavus*. As is usual with pocket mice, the entrances to the burrows were closed during the daytime.

In early November, specimens of *apache* were caught in traps set for harvest mice in a sandy weed patch on the Medano ranch, near the San Luis Lakes. They were taken beneath bushes of *Chrysothamnus patens*, but no burrows were found attributable to the species. One specimen got into a trap between 9 a. m. and 4 p. m. on a bright day. This individual evidently had been out foraging, as each of its cheek pouches contained nearly a thimbleful of the seeds of a honey plant (*Peritoma sonoræ*). These seeds numbered 164, and averaged about the size of No. 4 shot.

(?) **Perognathus callistus** Osgood. Red Desert Pocket Mouse.

While encamped on Snake River, southeast of Sunny Peak, Routt County, in August, 1906, numerous signs of a medium-sized pocket mouse were found on the first bench south of the river valley. Characteristic small heaps of dry earth had been recently ejected from most of the burrows, which were usually beneath bunches of prickly pear (*Opuntia polyacantha*). However, a large number of traps kept out for several nights failed to yield a specimen, owing chiefly to the abundance of white-footed mice, which were continually getting into the traps during the early evening hours. Signs of pocket mice were not observed elsewhere in northwestern Colorado, or at any point north of the Grand River Valley, although much of the region seems well suited to their needs.

The type locality of *P. callistus* is Kinney ranch, Wyoming, 40 miles northwest of Sunny Peak. The character of the country at both localities is similar, and it seems reasonable to treat the Snake River pocket mice as of this species. (See fig. 22.)

Zapus hudsonius campestris Preble. Prairie Jumping Mouse.

This Great Plains representative of the common northern jumping mouse enters Colorado along the South Platte Valley. (See fig. 24.) Thus far it has been found in this State only on the plains at the eastern base of the foothills. In July, 1895, Preble trapped two specimens in a dense growth of weeds along an irrigating ditch at Loveland. One in the Merriam collection was taken at Denver by A. W. Anthony, September 13, 1885. Warren says it is reported from Greeley by A. E. Beardsley.[1]

Zapus princeps Allen. Rocky Mountain Jumping Mouse.

> *Zapus princeps* Allen, Bull. Am. Mus. Nat. Hist., V, p. 71, 1893. Type from Florida, La Plata County, Colorado.

In the Colorado mountains this large jumping mouse is chiefly an inhabitant of the Canadian zone, but it also follows down some of the streams into the Transition zone. It frequents the dense growth of

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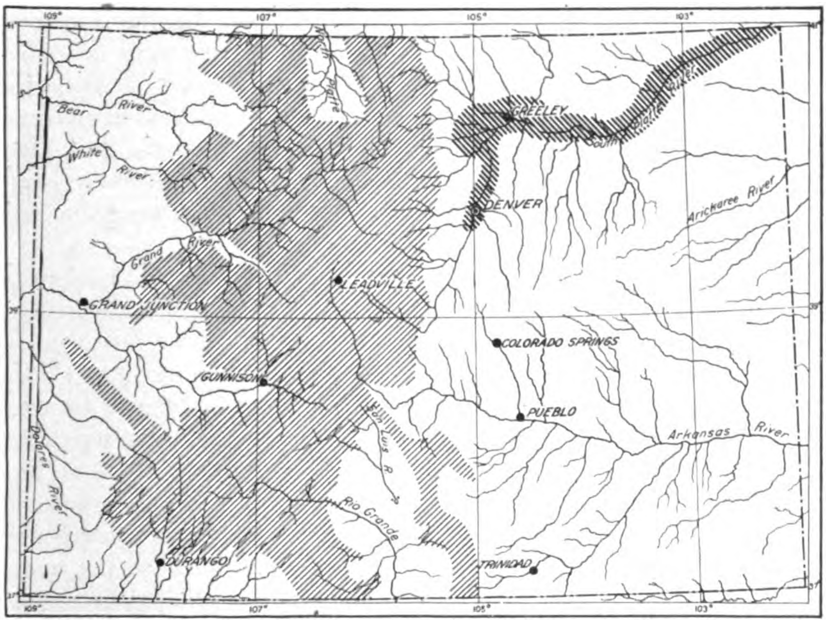
[1] Mammals of Colorado, p. 254, 1906.

Heracleum lanatum and other rank vegetation bordering cold mountain bogs and streams, but is also occasionally taken beneath logs in heavy forest. The species has a wide distribution in the mountainous parts (see fig. 24), but is nowhere abundant. Bailey says it is found in some of the marshes of the San Luis Valley. Near Del Norte he noted long lengths of grass stems which had recently been cut by jumping mice, while a specimen from east of Antonito was taken "in the grassy woods along the Conejos River, where most of the plants are Transition zone species which follow the river bottoms down into Upper Sonoran zone." Ranchmen near Meeker, Rio Blanco County, state that during the haying season jumping mice are often seen in the meadows bordering White River. The vertical distribution of this species is indicated by specimens from Meeker (6,000 feet) and Arapahoe Pass (over 9,000 feet).



▨ ZAPUS PRINCEPS. ▩ ZAPUS H. CAMPESTRIS.

FIG. 24.—Distribution in Colorado of jumping mice (genus *Zapus*).

Erethizon epixanthum Brandt. Yellow-haired Porcupine.

Yellow-haired porcupines are more or less abundant throughout the mountains, but are most often seen in the coniferous forests of the Canadian zone. They occur regularly to timberline, and in the Grays Peak region are said to be found occasionally among the rocks far above the limit of trees. They are reported sparingly from the yellow pine belt of the eastern and southern foothills, and even extend down into the juniper and pinyon country in some of the southwestern counties.

Porcupines are reported to be common in the following localities: Middle and North Parks; Elk Head Mountains; White River Plateau; St. Elmo, Saguache Mountains; San Miguel Mountains; Lake City; San Juan Mountains, north of Pagosa Springs and Vallecito; La Plata Mountains, northeast of Mancos; and Culebra Mountains, near La Veta. I saw parts of a skin, but recently removed, at Highbridge, on Berthoud Pass, in October, 1906, and a dead porcupine was found in the trail east of Lake San Cristobal in the San Juan Mountains at 10,000 feet, while I have found quills in a mountain rat's nest near Mount Whiteley in northwestern Middle Park. In the foothills west of Antonito, Conejos County, Bailey saw numerous Douglas spruces and pinyons which had been partly divested of bark by porcupines, and also found a great many porcupine pellets in caverns beneath the broken lava rock; while farther north in the San Luis Valley two or three porcupines are said to have been killed by cowboys in the open valley on the Medano Springs ranch, near the San Luis Lakes.

The food of porcupines consists largely of the bark of coniferous trees, and the lodgepole pine seems to be preferred to firs and spruces. Occasionally such large areas of bark are gnawed from a tree that it dies. A porcupine was seen in an Engelmann spruce on Lone Cone, at an elevation of 11,000 feet, July 27, 1907, and I saw many spruces between 10,000 and 11,000 feet from which the bark had been partially stripped between 20 and 30 feet above the ground. Most of the yellow pines seen along the railroad in the valley a mile south of Vance Junction, San Miguel County, July 1, showed evidences of porcupine work in large sections divested of bark, on both the main trunks and the larger branches. The injury thus inflicted upon the coniferous forests throughout the mountains must be considerable. The animals feed to a small extent, at least, upon the aspen, since in 1905 I saw a number of these trees, both in the Rabbit Ear Mountains and on the White River Plateau, from which the bark had been gnawed at a height of 10 or 12 feet.

Owing to their sluggish movements, porcupines fall an easy prey to some of the larger predaceous mammals. On this point Warren remarks: "In spite of its protecting quills, it is eaten by coyotes, mountain lions, and bobcats, though possibly only in winter when other food is scarce, that being the only season when the writer has found remains of the animal so killed.[1]

Trippe records the porcupine as an inhabitant of Clear Creek County in the early days;[2] while Allen says it was common from foothills to timberline in Park County in 1871, and also reports it from the regions bordering the headwaters of the Arkansas and Del Norte [Rio Grande] Rivers.[1]

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[1] Mammals of Colorado, p. 254, 1906.

[2] See Coues, Birds of the Northwest, p. 225, 1874.

Ochotona saxatilis Bangs. Rock Cony; Pika.

Ochotona saxatilis Bangs, Proc. N. Eng. Zool. Club, I, p. 41, 1899. Type from near timberline, Snowy Range, Park County, Colorado.

The peculiar little rock cony is one of the characteristic mammals in the timberline region of the high mountain ranges. It is most abundant in the rock slides at or near timberline, but has been found also near the summits of the highest peaks, and on some of the western plateaus as low as 8,500 feet.

Conies are very abundant at 12,000 feet in the Grays Peak region and on Rollins Pass, and a little lower on Berthoud Pass. I heard of a small colony in slide rock near Arapahoe Pass, in the Rabbit Ear Mountains, at 9,000 feet. Frank Hayes, a taxidermist of Glenwood Springs, secured several specimens in rock slides near the head of Noname Creek, Garfield County, at an elevation of only 8,500 feet. Warren mentions seeing conies as low as 9,300 feet near Crested Butte.[2] They were reported from the San Juan Mountains, north of Pagosa Springs and Vallecito; La Plata Mountains, northeast of Mancos; Saguache Mountains, near St. Elmo; Lone Cone, San Miguel Mountains; and on the Sierra Blanca group. Prof. Lantz found them abundant on Pikes Peak between 12,000 and 13,500 feet.

The habits of conies are most interesting. As far as my observation goes, they live entirely in slide rock, usually on steep slopes, but near Silverton Loring found their characteristic haystacks in the crevices of lumber and slab piles near an abandoned sawmill; while Mr. D. Costello, of Gardner, tells of a cony which took up its abode beneath the floor of a cabin in the mountains north of Crested Butte.[3] The haystacks of these industrious little animals, comprising their winter food, are composed of many species of grasses and weeds, cut and gathered in summer, and allowed to dry among the rocks. Thistles are found in most of the stacks, and seem to be a favorite food. Well-worn runways lead from one stack to another and extend to neighboring rock slides. Conies are usually quite shy and would be seldom observed were it not for the odd, complaining notes which they utter continually when alarmed. The grayish color of the animal closely matches the dull-colored rocks in which it is found, and the notes often appear to come from a distant pile of rocks when in reality the motionless animal is within a few feet; or, again, the reverse may be true.

There are specimens from Mount Kelso; Longs Peak; Bald Mountain, 5 miles west of Ward; Sand Mountain, near Hahns Peak; Lake

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[1] Bull. Essex Inst., VI, pp. 57 and 66, 1874.

[2] Mammals of Colorado, p. 254, 1906.

[3] See under *Putorius streatori leptus*, p. 188.

City; Cumbres; and Silverton. The type and a large topotype series of *O. saxatilis* were collected by an expedition of the Museum of Comparative Zoology on the Snowy Range near Montgomery, Park County, in 1871. Mr. E. Thompson Seton has collected the species on Pagoda Peak, in eastern Rio Blanco County.

Lepus campestris Bachman. White-tailed Jack Rabbit.

This fine species is rather generally distributed over the eastern plains, except south of the Arkansas River, where it appears to be absent in some sections and sparingly present in others. It occurs also in considerable numbers in the mountain parks on the eastern slope of the mountains, to an elevation of 10,000 feet, but not west of the Continental Divide, being replaced there by the grayer form, *L. c. townsendi.* It is far more abundant in northern than in southern Colorado. At no point is it more numerous than in North Park, and in this region and the San Luis Valley I found it far more abundant than on the plains east of the mountains.

The white-tailed jack rabbits of the eastern plains are typical *L. campestris,* but those of the higher elevations are less yellowish and more grayish, showing an approach toward *townsendi.* This departure is well indicated in specimens from the immediate eastern slopes of the Continental Divide, as in the upper Arkansas Valley and in the northern and western parts of the San Luis Valley. Two females which Warren collected at 12,000 feet on the summit of Boreas Pass in early August are very gray, and are clearly referable to *townsendi;* while a male which I collected August 22 at Como, on the grassy South Park plains just below the eastern end of the Boreas Pass, at 9,800 feet, is nearest the *campestris* type.

In North Park white-tailed jack rabbits were very abundant in 1905. Early one morning in July, in a half hour's ride along Grizzly Creek near Hebron, I counted 19, most of which were feeding in alfalfa fields on the bottoms. Formerly jack rabbits were so numerous and so destructive to crops in the San Luis Valley that prize hunts were held each year and many thousands were killed. They are still found throughout the valley, but are common only in the sandy strip of country lying along the west base of the Sangre de Cristo Range. At the Medano Springs ranch, near the San Luis Lakes, I found them abundant in October, 1907, and shot six specimens among the *Sarcobatus* and *Chrysothamnus* bushes on the sand ridges. All of these, as well as others examined at the Medano ranch, had the upper central area of the tail heavily shaded with plumbeous, but the cowboys report that a lighter colored rabbit with the tail entirely white is occasionally killed in that region.

White-tailed jack rabbits are said to be not uncommon near Westcliffe, in the Wet Mountain Valley, and a few are reported near Bradford and La Veta, in western Huerfano County. One was collected December 5, 1907, in the dense yellow pine forest west of Eastonville. In some sections on the plains this species is becoming scarce of late years, and the numbers are rapidly decreasing throughout the plains region as the country becomes more settled. This is well illustrated by the fact that in May and June, 1909, I saw only one individual in the course of a wagon trip of over 300 miles, from Cheyenne Wells northwest to the Wyoming line, north of Grover. At certain localities *L. melanotis* appears to be replacing *campestris*. I saw a white-tailed jack rabbit just west of Fort Collins in 1906, and heard of a few at Wray, Yuma County, in December, 1907, although the predominant species at the last locality is *melanotis*. *L. campestris* was said in 1907 to occur very rarely along the east edge of Baca County, but I was unable to verify the report. In 1909 I saw one on the Arkansas Divide near Resolis. Among the eastern foothills of the Front Range it ranges as high as Estes Park and Gold Hill.

Alien found this species common in the parks of Park County in 1871,[1] while Trippe recorded it as common in Clear Creek County.[2]

Lepus campestris townsendi Bachman. Western White-tailed Jack Rabbit.

This is the western gray form of the white-tailed jack rabbit, and in Colorado, at least, is more an inhabitant of the mountains than its eastern relative. Though not unlike *L. campestris*, and scarcely distinguishable in the field, *L. townsendi* is much grayer, and a blackish or plumbeous area on the upper central part of the tail is almost always well indicated. It replaces *L. campestris* in the mountains west of the Continental Divide, and may occur regularly along its crest, since it has been taken at extreme timberline on Boreas Pass, at 12,000 feet. Specimens from just east of the Rocky Mountain watershed, in South Park and the upper Arkansas and San Luis Valleys, are best referred to *campestris*, though evidently intergrades.[3]

This rabbit occurs sparingly in the sagebrush country at Norwood and Coventry between 6,500 and 7,000 feet, but Mr. C. H. Smith says that at both localities it is outnumbered fully 10 to 1 by the black-tailed species *L. c. texianus*. During July, 1907, I saw only one at Coventry, but another was seen at the west base of Lone Cone, in the San Miguel Mountains, July 26. This was in a grassy opening among the dense oak chaparral at about 9,000 feet. Mr. J. P. Galloway, of Norwood, states that white-tailed jack rabbits are not uncommon on the lower slopes of Lone Cone. Tracks of jack rabbits were seen in the sandy, yellow pine country near the head of Dominguez Creek, on the Uncompahgre Plateau, at 8,500 feet, July 15. The form represented on this plateau is undoubtedly *L. townsendi*, as the region is too high for *texianus*.

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[1] Bull. Essex Inst., VI, p. 58, 1874.

[2] See Coues, Birds of the Northwest, p. 225, 1874.

[3] See Nelson, N. Am. Fauna No. 29, p. 81, 1909.

The white-tailed jack rabbits inhabiting the sage plains of western Routt County probably reach that region from the Wyoming plains on the north. As no specimens from that region are at hand, it can not be stated with certainty whether they are *townsendi* or *campestris*. From geographical considerations alone they might be referred equally well to either. In 1906 one was noted in the Snake River Valley west of Baggs Crossing, and tracks were noticed south of Sunny Peak. Another rabbit was seen at Douglas Spring at the northern base of the Escalante Hills, and the species was reported present throughout the Snake and Bear River region. Rabbits reported from the White River Valley above Meeker,[1] Egeria Park, and on the Gore Range, and others seen in Middle Park, can be referred without much question to *L. townsendi*.

Warren gives the following data regarding this form in the higher mountains: "Two females killed near Boreas Pass, in Summit County, each contained fœtuses, one four, the other five; one lot would probably have been born within a day or two, the other in about a week. This was on the 5th day of August. It seems very late in the season for young to be born at such high altitude, where winter sets in so early, one might say in mid-October frequently, and these rabbits are reported to live in these high regions the year round. Mr. H. L. Curtiss writes me he has seen them in winter on Fairview Mountain, near Pitkin, Gunnison County, at 12,000 feet."[2] Warren told me that the Boreas Pass specimens were jumped from beneath the dwarfed and matted Engelmann spruces at extreme timberline on Baldy Mountain, and that other hunters had found this rabbit in similar situations along the crest of the Front Range, where the animals obtain in the stunted and matted conifers protection from the icy winds which sweep the bleak and inhospitable summits. In the high mountain districts both *townsendi* and *campestris* assume a beautiful whitish winter coat, but do not become as white as the snowshoe rabbit (*L. bairdi*).

Lepus bairdi Hayden. Rocky Mountain Snowshoe Rabbit.

The large furry-footed snowshoe rabbits are found throughout the higher mountains from the lower edge of the Canadian zone at 8,500 feet to considerably above timberline. Along the lower edge of their range they meet the mountain cottontail rabbit (*Sylvilagus n. pinetis*), but above 9,000 or 9,500 feet *L. bairdi* is often the only rabbit present. I have seen very few of these rabbits on my trips through the mountains, but the tracks of their large furry feet and the well-worn trails in the snow which wind in and out of the dense willow copses in the gulches just below timberline show that considerable numbers are present in most sections.

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[1] Felger. Univ. of Colo. Studies, VII, p. 144, 1910.

[2] Further Notes on Mammals of Colo., p. 79, 1908.

Snowshoe rabbits are adepts at hiding in the cover of forest vegetation and easily escape notice. In the gloaming of an August evening one was discovered feeding in the willows which fringed a spring on the White River Plateau, 25 miles southeast of Meeker, at 8,500 feet, and it allowed a close approach before hopping unconcernedly into a denser thicket. Another got into a trap set under a cabin near Coulter, Middle Park, in the middle of October. The weather was cold and wintry, but this specimen had just begun to assume the white winter pelage on the legs and flanks. Lumbermen at Fraser, Middle Park, report snowshoe rabbits abundant, and often find them living under log piles and brush heaps. While following a logging trail near Fraser I discovered the remains of a rabbit which had been captured by a bobcat during the previous night. Bobcats and coyotes living in the higher mountains feed quite extensively upon this species, and on Berthoud Pass their tracks were often seen in the snow where they had been hunting rabbits among the willow copses near timberline. In June, 1905, rabbit signs were abundant among the alpine willows far above timberline on Mount Kelso, near Grays Peak. The species is said to be common in the forests of the Gore Range, east of Toponas; at Hahns Peak; in the San Juan Mountains, north of Pagosa Springs and Vallecito; on Lone Cone, San Miguel Mountains; and on Veta Pass. I found it very rare in the Saguache Mountains, near St. Elmo, Chaffee County. According to Preble it was tolerably common on Longs Peak in August, 1894, while Loring secured a fine series of 28 specimens at Silverton in the latter part of October, 1893. The majority of the Silverton specimens were collected in underbrush in the canyon, but a few were taken on the mountain sides near timberline. All were changing from brown summer pelage to the white winter coat, and Loring states that the white pelage was farthest advanced on individuals taken near timberline. Allen says snowshoe rabbits were reported as common in the timbered parts of Park County in 1871.[1]

Lepus californicus melanotis Mearns. Kansas Jack Rabbit.

Over the entire plains region of eastern Colorado black-tailed jack rabbits are found in varying abundance. (See fig. 25.) Formerly they were outnumbered by *L. campestris* in many sections on the northern plains, but the reverse is now true. They become increasingly numerous toward the south, where *campestris* is rare or absent. In Huerfano County, and doubtless elsewhere, they follow some of the widest valleys into the foothills, and may be found occasionally among the junipers and pinyons as high as 7,500 feet. The species seems to prefer open grassy plains to the foothill valleys grown up with *Atriplex* and *Chrysothamnus* and is most abundant at some distance from the mountains.

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[1] Bull. Essex Inst., VI, p. 58, 1874.

Although present in much smaller numbers than formerly, black-tailed jack rabbits are still sufficiently numerous in certain sections, particularly in the rich agricultural region lying along the Arkansas River, to injure seriously such crops as alfalfa, grains, cabbages, and sugar beets. In early days jack rabbits were extremely abundant in the Arkansas Valley, and for a number of years annual hunts were organized at Lamar to lessen the pest. Many thousand jack rabbits were sometimes killed in a single hunt.[1]

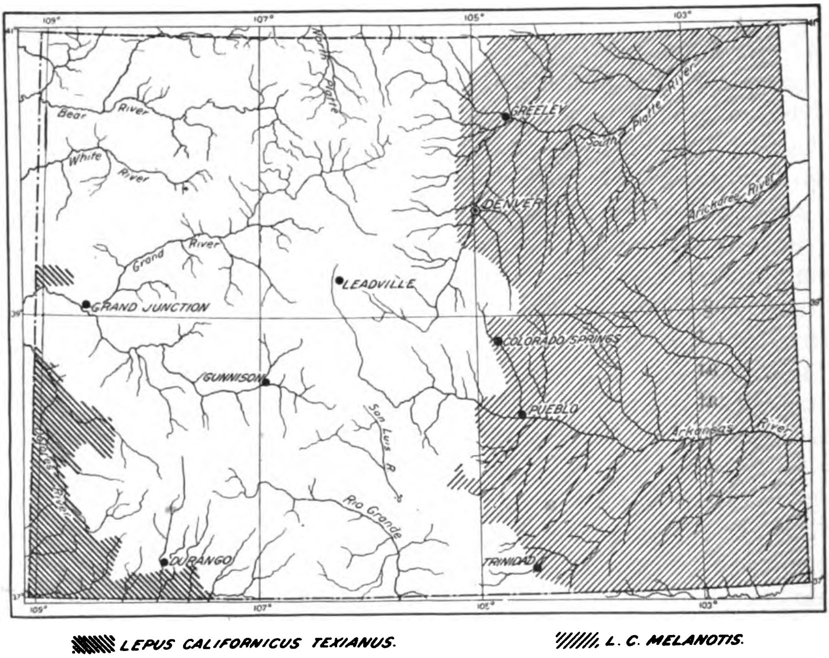

FIG. 25.—Distribution in Colorado of black-tailed jack rabbits (*Lepus californicus texianus* and *L. c. melanotis*).

In driving from Cheyenne Wells northwest across the plains to Cheyenne, Wyoming, in May and June, 1909, I found these jack rabbits common only in the sandy bunch grass country of Yuma County. Elsewhere they appeared to be greatly reduced in numbers. A very few were seen on the eastern end of the Arkansas Divide, and farther west at River Bend and Ramah, while two immature individuals were encountered near Pawnee Buttes, in northeastern Weld County. Prof. Lantz found them abundant in the Purgatory Valley south of La Junta in April, 1910.

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[1] For details of the Lamar rabbit hunts see Jack Rabbits of the United States, by T. S. Palmer, Bull. No. 8, Biological Survey, pp. 63–64, 1897.

Lepus californicus texianus Waterhouse. Texas Jack Rabbit.

The black-tailed jack rabbits inhabiting the Upper Sonoran desert valleys of western and southwestern Colorado (see fig. 25) are referable to the Texas form, although intermediate in coloration between *texianus* and *melanotis*.[1] In some sections they are abundant, in others very scarce, and their local abundance varies much from year to year, as in other parts of their range.

In the summer of 1907 I found jack rabbits common at Bayfield, La Plata County, and at Coventry, Montrose County. Small numbers were reported also on Mesa Verde, in McElmo Valley; near Mancos and Dolores in Montezuma County; and between Naturita and Paradox in western Montrose County. Early in June the rabbits were quite common along the lower edge of the pinyons and in the adjoining open sagebrush valleys and slopes southwest of Bayfield, at 6,500 feet. During the heat of the day they were usually resting quietly in the shade of the pinyons, but in the early morning and toward sundown could be seen actively moving about in the open, either nibbling at the short grass in the openings among the sagebrush or more often feeding in the grain and alfalfa fields. Several ranchmen southwest of Bayfield have small patches of grain in the openings along the lower edge of the pinyons, and these suffer most from the depredations of jack rabbits. One forenoon at 10 I surprised an entire family of rabbits eagerly feeding in one of these small isolated fields of young grain among the pinyons. This family, consisting of two adults and three or four young about two-thirds grown, had been levying heavy tribute upon the tender grain shoots, and the field was in a fair way to be entirely destroyed. A very little time and effort spent by the owner of this piece of grain in shooting jack rabbits would in all probability have saved it. Mr. E. G. Bates, of Bayfield, states that a diet of young alfalfa produces the same bloating effect on jack rabbits as on cattle and usually results fatally. No rabbits thus affected have come under my observation, unless it be in the case of a much bloated individual which I found lying dead in the sagebrush a short distance from a large alfalfa field near Coventry. In the Bayfield region jack rabbits are said to be very injurious to orchards in winter, when green food is scarce and the animals are forced to subsist by browsing and by eating the tender bark of young trees.

Black-tailed jack rabbits are not common in eastern Montezuma County, but toward the Utah boundary and thence west to the Abajo (Blue) Mountains in eastern Utah, their numbers are said to increase rapidly. I saw a single individual on a flat in the McElmo Canyon, near Moqui, June 22. North of the Montezuma Valley

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[1] See Nelson, N. Am. Fauna No. 29, p. 145, 1909.

texianus follows the pinyon and sagebrush country around the western ends of the Dolores and San Miguel Plateaus, chiefly west of the Dolores River, and reaches the San Miguel and Naturita Valleys through the Paradox Valley and Dry Creek Basin. It ranges eastward along San Miguel River to Coventry and Norwood and follows Naturita Creek nearly to its head at the northwest base of Lone Cone, where I saw one in a grassy opening in the oak chaparral at 8,500 feet, July 27, 1907. At the last three localities the range of this species overlaps that of the white-tailed *L. c. townsendi*, *texianus* being the common form in the lower elevations at Coventry and Norwood, and *townsendi* predominating up around the base of Lone Cone, in the Transition zone. I saw no jack rabbits while crossing the Paradox Valley on my way to the La Sal Mountains in July, but tracks were common in East Paradox Valley. Mr. C. H. Smith, of Coventry, reports them very injurious to growing grain, alfalfa, and vegetables, especially cabbages. Most of the cultivated land there is surrounded by a dense growth of sagebrush, which affords the rabbits effective concealment during the day and ample protection, as I can testify after several days of hunting with poor success.

A few black-tailed jack rabbits are reported in the desert areas of the lower Grand River Valley between Grand Junction and the Utah boundary. They are said to occur in small numbers near Douglas Spring, at the north base of the Escalante Hills, in western Routt County, but this report lacks verification. Mr. J. H. Gaut saw a black-tailed jack rabbit east of Antonito, in the Rio Grande Valley, in September, 1904, but as it was not secured its species can not be determined. On geographic grounds it should be *texianus*.

Sylvilagus floridanus similis Nelson. Nebraska Cottontail.

This small gray form of the small-eared *floridanus* group of cottontail rabbits comes into the State from the northeast, along the valleys of the South Platte and Republican Rivers and their tributaries, and ranges to the eastern base of the foothills, as indicated by the following localities at which specimens have been collected: Arvada, Jefferson County; Littleton; Barr; Orchard, Morgan County; Masters, Weld County; Dry Willow Creek, Yuma County; and Sterling. Mr. W. L. Burnett states that a specimen has been taken near Loveland.

Little is known of the habits of this cottontail in Colorado aside from the fact that most of the specimens have been taken in brushy thickets along watercourses, just as farther east. *S. a. baileyi* occurs on the plains on both sides of the Platte from the base of the foothills to the Nebraska line; so *similis* doubtless inhabits the wild plum thickets and the willow and cottonwood fringe along the river banks.

Cottontails were very scarce at Wray in December, 1907, but I saw a few tracks in the dense plum and hackberry thickets in the gulches south of Chief Creek, where *similis* should be found. A skull, however, found at a hole beneath a rocky ledge along one of the gulches had the characteristic large audital bullæ of *baileyi*. *S. similis* can be distinguished readily from *baileyi* by its much smaller and shorter ears and small audital bullæ. The only other Colorado cottontail which shares these characters is *S. pinetis*, a species restricted to the mountains. At Sterling, in June, 1909, I found this cottontail restricted to the immediate valley of the Platte, where one was occasionally jumped in the dense thickets of wild cherry and snowberry along the river. They were very wild, and the only one collected was a nursing female shot in an alfalfa meadow along the roadside June 2.

Sylvilagus nuttalli pinetis (Allen). Rocky Mountain Cottontail.

This is the cottontail of the mountain districts of Colorado, where it is generally distributed, mainly in the Transition zone. It is most abundant in the yellow pine forests of the eastern foothills of the front ranges, but is often found along the lower edge of the aspen belt. In the Pikes Peak region it occurs as high as 11,500 feet.[1] It is common on some of the pinyon-clad ridges and mesas of western Colorado as low as 6,000 feet along the upper edge of the Upper Sonoran zone; and has been taken on the higher sage plains of Routt County with *baileyi*. The favorite abode of the mountain cottontail is on the cool north slopes in the upper part of the pine belt, where it finds abundant cover in the creeping juniper (*Juniperus sibirica*) and in dense thickets of aspens, as well as in and among fallen logs. Ledges of rock and hollow logs are favorite retreats. This cottontail, like *grangeri*, belongs to the short-eared *nuttalli* group, and can not be easily confused with the long-eared cottontails, *baileyi* and *warreni*, of the surrounding Upper Sonoran plains and valleys. The rich dark winter pelage of *pinetis* is usually strongly tinged with vinaceous.

Sylvilagus nuttalli grangeri (Allen). Black Hills Cottontail.

E. W. Nelson, in his recently published monograph of the rabbits of North America,[2] refers to this form specimens of cottontails from the Escalante Hills and Lay, in western Routt County, and from Meeker. This is a northern member of the *nuttalli* group closely related to *pinetis*, with which it intergrades in southern Wyoming. *S. a. baileyi*, a member of the long-eared *auduboni* group, is also found over much of western Routt County. The cottontail rabbits of northwestern Colorado are not typical of any race, but appear to be intergrades—*grangeri*, *pinetis*, and possibly *baileyi*, being involved. A specimen I shot on the sage plains near Lay in August, 1905, seems to be intermediate between *baileyi* and *grangeri*. The cottontails of the northwestern sage plains thus present a most perplexing problem. To quote Mr. Nelson (l. c., p. 206): "One specimen in the Biological Survey collection (No. 139098) from Lay, Colorado, is indistinguishable in external characters from three specimens of *S. a. baileyi* from the same place, but its skull is that of *grangeri*, to which it has been referred. Several other specimens of cottontails, some *baileyi* and some *grangeri*, from northwestern Colorado are extremely puzzling, and much more material from there and elsewhere in this State is needed before the relationships and ranges of the several cottontails can be satisfactorily determined."

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[1] Warren, The Mammals of Colorado, p. 49, 1910.

[2] N. Am. Fauna No. 29, p. 207, 1909.

In the Escalante Hills I found the short-eared cottontails in small numbers at the edge of the yellow pines at about 7,000 feet, and others were seen down among the dense pinyon and juniper growth on the northern slopes.

Sylvilagus auduboni baileyi (Merriam). Plains Cottontail.

The common long-eared cottontails of the eastern plains of Colorado are *baileyi*, the only other form occurring there being the short-eared *similis*, which inhabits the brush patches and fringe along the South Platte and other streams of the northeastern counties. These two cottontails are quite unlike, and besides their structural differences have dissimilar habits. Thus *baileyi* inhabits the open grassy plains, where it lives in abandoned prairie dog and badger holes, or else takes up its abode in the rock ledges and bluffs bordering the valleys; while *similis*, so far as known, does not dwell in the open but in dense thickets along streams and in the bottoms of connecting gulches. The plains cottontail has a wide range from Montana south to the edge of the Llano Estacado of northern Texas. It occupies practically all the plains of Wyoming, extending south in northwestern Colorado on the sage plains and in the valleys of Routt and Rio Blanco Counties, where the high escarpment of the Book Cliffs and the White River Plateau separates it from *warreni* of the Grand Valley and southward. The range of *baileyi* meets that of the mountain cottontail (*S. pinetis*) at Meeker, Craig, and other points along the bases of the Elk Head Mountains and of the White River Plateau, as well as on the slopes of the higher divides between the river valleys. This species follows up the drainage of the Arkansas Valley to Salida, and probably occurs on the extensive Upper Sonoran flats farther up the valley, but in other sections is not known to penetrate the eastern foothills for any distance.

Throughout its range the plains cottontail is preeminently an inhabitant of the semiarid Upper Sonoran plains, where it lives in holes along the steep-cut banks of dry arroyos, in the deserted burrows of prairie dogs and badgers, and often in holes beneath sagebrush, *Atriplex*, or prickly pear (*Opuntia polyacantha*) on the open plain. In rough and broken regions, as along the Snake, Bear, and White Rivers, and in the juniper country of Baca and Las Animas Counties, it lives chiefly along the rocky rims of canyons.

In August, 1905, cottontails were abundant in the Bear River Valley south of Lay. In the evening and early morning, and often at midday, numbers usually fed on the small grassy flats between the river and the base of the bluffs. They were quite wild, despite their abundance, and when alarmed scampered up the arroyos and dry rocky slopes in all directions to their retreats in the ledges far above the river. Sometimes fully 20 individuals, adults and young, were in sight at once.

In traveling down the Snake River Valley in August, 1906, few cottontails were observed as compared with the great numbers seen on Bear River in 1905, and Mr. John Criss, of Baggs Crossing, Wyoming, informed me that a disease which he termed cholera had been thinning out their numbers very perceptibly throughout the region. In common with other rabbits *baileyi* is subject to a periodical disease, as yet very little understood, which invariably follows excessive abundance. This disease seems to be nature's check to abnormal increase, and did it not prevail, at least among the plains cottontails, much of the cattle range in the vicinity of streams and gulches would undoubtedly be ruined. As it is, the injury to the range is very considerable when the rabbits reach their maximum numbers, as on Bear River in 1905, and again on McElmo Creek and along the lower San Juan River in 1907, where *S. a. warreni* was so abundant that scarcely a spear of grass remained in the vicinity of the streams.

This species is fairly free from parasites and grubs and, except in the years when it is suffering from disease, is excellent food. On the sage plains of Routt County young cottontails were an important item on our bill of fare, and they were well-flavored and tender.

Sylvilagus auduboni warreni Nelson. Colorado Cottontail.

Sylvilagus auduboni warreni Nelson, Proc. Biol. Soc. Wash., XX, p. 83, July 22, 1907. Type from Coventry, Montrose County, Colorado.

This is the cottontail of the warm Upper Sonoran valleys and lowest mesas of southwestern Colorado south of Grand River Valley. The cottontails of the open plains of the San Luis Valley, although not typical, are referable to this form and, especially toward the northern end of the valley, approach *baileyi* in general paleness of coloration. The ranges of these two closely related forms appear to meet in this region, *warreni* doubtless extending around the southern end of the San Juan Mountains in New Mexico and then north into the San Luis Valley, while *baileyi* probably reaches the region from the south and east by following around the southern end of the Culebra Range. Under the circumstances it seems best to refer all of the San Luis Valley cottontails to *warreni*, since this type predominates. The northern boundary of the dispersion of *warreni* is marked by the White River and Book Plateaus, the cottontails found in the Grand Valley as far east as Rifle being fairly typical, while those occurring in the White River Valley from Meeker west are *baileyi*.

This form, like the other long-eared cottontails, is an inhabitant of sage plains, *Sarcobatus* valleys, and *Atriplex* flats, and is often found also among the rocks and pinyons. Cottontails were uncommon in the Grand Valley in both 1906 and 1907. Near Rifle, several were seen in the greasewood along arroyos and irrigation ditches, and north of Fruita, Mesa County, the rabbits were often started from their forms beneath *Atriplex confertifolia* on the open desert, or from the dense thickets of *Chrysothamnus* along the irrigation ditches. They invariably took refuge in the deserted burrows of badgers and white-tailed prairie dogs, in which apparently they were living. They were abundant at Hotchkiss in August, 1907, and one seen just east of Crawford, at the west base of the West Elk Mountains, was probably this form. At Coventry I found them abundant during July, both among the pinyons and out in the sagebrush, and collected several topotypes. On my trip to the La Sal Mountains they were seen in abundance in the Dry Creek and Paradox Valleys, but were scarce in Sinbad Valley and thence down the Dolores River to the mouth of West Creek. My camp assistant shot 11 young cottontails from the tent while cooking supper at our Dry Creek camp, 3 miles west of Naturita, July 19, and there seemed to be fully as many more among the rocks and sagebrush after his fusillade.

These rabbits were very abundant in the McElmo and San Juan Valleys in June, 1907, where they were reported quite injurious. Ranchmen stated that their numbers near Bluff City, Utah, were so great that nearly all the range grasses in the vicinity of canyons had been eaten by them before the middle of June. Mr. George J. Ashbaugh, who lives in the McElmo Canyon west of Moqui, says the cottontails are very injurious to his fruit trees during the winter. On the Mesa Verde these rabbits are scarce, only two being seen among the pinyons at 7,000 feet. They were fairly common at Bayfield, La Plata County, early in June, and a single individual noted in a willow copse along the San Juan River at Arboles may have been this form.

The type of this interesting cottontail, a female in winter pelage, measures: Total length, 375; tail vertebræ, 51; hind foot, 102; length of ear from notch, in dried skin, 70. It was collected at Coventry by Mr. C. H. Smith, January 4, 1907, and is in the Biological Survey collection. Regarding the characters of *warreni*, Nelson says (l. c.):

"Similar to *baileyi* in size, length of ears, and abundant pelage, but darker colored with more distinct gray rump patch and darker rufous on nape and legs." Its distribution is given as "southwestern Colorado and adjacent parts of Utah, New Mexico, and Arizona."

Felis oregonensis hippolestes Merriam. Cougar; Mountain Lion.

The mountain lion was formerly present over at least all the rough parts of the State, and in early times it was occasionally seen even well out on the plains along the more heavily brush-fringed streams. At present it is becoming rare east of the Continental Divide, although holding its own fairly well in the rough canyon and mesa country of the west and southwest. It is now most numerous in the pinyon country of Montezuma and Dolores Counties, and in western Rio Blanco and Routt Counties, the latter region being to-day perhaps the best lion country in the United States.

Probably *F. hippolestes* is the only form represented in Colorado, but a skin from Montezuma County, in the possession of Mr. Steve Elkins, of Mancos, is considerably paler and less reddish than lions from the Meeker region. Unfortunately there are no skulls or skins from extreme southwestern Colorado available for study. A series of 12 skulls from Meeker in the Biological Survey collection, collected by Mr. Theodore Roosevelt in January and February, 1901, have been referred to *F. hippolestes.*[1]

In some of the southern and western counties mountain lions are sufficiently numerous to be very destructive to stock, especially young colts. Near Lily Park, in western Routt County, calves also are said to be often killed by lions. Through Mr. James Lowell, of Dolores, a forest ranger, I learned that 16 colts had been killed by mountain lions in that region during the spring of 1907—11 in the yellow pine country between Plateau and Beaver Creeks, 20 miles north of Dolores, and 5 in the high aspen and spruce country on Bear Creek, an affluent of the Dolores River, about 20 miles east of Dolores. In addition to colts and calves, the lions prey much upon wandering bands of sheep in the yellow pine forests of Archuleta County.

Among game mammals deer appear to suffer most from mountain lions, and that they form the chief prey is evident from the fact that the lions move up into the mountains or down into the low country with the migration of the deer. Mr. E. E. Chapson, a forest ranger in the San Juan National Forest, thinks the lions and coyotes are the most important factors in the destruction of deer in the San Juan Mountains. The lion tracks seen in winter are almost invariably following deer trails, and, as the bodies of deer which have been killed by mountain lions are often found, Mr. Chapson thinks they kill many more deer than they require for food. Mr. Steve Elkins states that lions are very destructive to deer in the Montezuma National Forest. Mr. J. P. Galloway, of Norwood, relates that a lion, the track of which he followed several years ago on Wild Steer Mesa, south of East Paradox Valley, had dragged the carcass of a freshly killed deer to a secluded rocky place among the pinyons and left it covered with a pile of pinyon needles and cones fully 4 feet high. This habit of caching carcasses for future consumption has been noted by a number of Colorado hunters.

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[1] Proc. Wash. Acad. Sci., III, p. 586, 1901.

Mountain lions are much hunted with dogs in the regions of their greatest abundance, as in the Keystone country northwest of Meeker and in the Mancos region. When pursued by dogs, they are readily treed, usually after a short dash, seeking refuge among the upper branches of pinyons or junipers, where they are at the mercy of the hunters. The Meeker region has long been a famous lion country, and it was here that Roosevelt had his well-known hunt in the winter of 1901, bringing out a fine series of specimens, besides gathering important data on the habits of the species.

Although most abundant in the broken rocky pinyon and juniper country on the lower western slope of the Continental Divide, lions are nevertheless found occasionally above timberline. On the Saguache Mountains, 2 miles north of St. Elmo, I followed the track of a medium-sized lion through the snow for some distance, October 9, 1907. It was first crossed at 12,000 feet, and as far as followed, kept along the high wind-swept crests of the mountains above timberline.

Mountain lions were reported in varying numbers at the following localities in the northern mountains in 1905 and 1906:

Gore Range and mountains surrounding Middle Park: Small numbers reported.

Park Range (headwaters of Grand Encampment River): Reported by lumbermen as not at all uncommon. Tracks seen in the trail near the tie camps August 13, 1906.

Snake River region (Baggs Crossing to Escalante): Formerly common, but none remain. Mostly poisoned by professional wolf trappers some years ago, when there was a large bounty on wolves in this region.[1]

Browns Park: Fair numbers reported in mountains south of Green River, near Mount Cullom.

Escalante Hills: Three killed on south slope, 10 miles west of Lily, in the winter of 1905–6.

Lily Park: Reported common in surrounding pinyon country in winter.

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[1] This suggests that a liberal use of poison in a region where lions are troublesome would be the best means of reducing their numbers. Old trappers and wolf hunters state that lions readily eat of poisoned carcasses.

Rangely (lower White River): Not uncommon. Several killed each winter.

Book Plateau (near Baxter Pass): Reported as occasional in winter.

The following data on the abundance of lions in southern Colorado were secured in 1907:

Culebra Range (south of La Veta): Reported not uncommon in wilder parts, but none recently killed. One killed on Cucharas River several years ago.

Sangre de Cristo Range (Sierra Blanca group): Reported rare. Track seen on Sierra Blanca winter of 1906–7.

Sangre de Cristo Range (head Huerfano River): A few reported.

Cochetopa Hills (near Saguache): Said to be scarce.

Mancos region: Three killed by Mr. Steve Elkins during past year. I saw a young lion's track in Navajo Canyon, on the Mesa Verde, June 13.

Sierra el Late: A few reported around Ute Peak.

Lower San Miguel and Dolores Rivers: Becoming scarce.

Lone Cone (San Miguel Mountains): Has never been common.

Coventry: Scarce. Several have been killed along the San Miguel River, but none recently.

Uncompahgre Plateau: Rare.

Vallecito: Occasionally met with.

Over much of the eastern slope mountain lions are very rare, where they were formerly common. Allen says, regarding its former presence in Park County: "Not uncommon. Its cry was once heard near our camp at Montgomery." [1] Trippe [2] records it as an early inhabitant of Clear Creek County. It was reported from Estes Park during the early nineties of last century. Coues mentions two mounted specimens in the collection of Colorado mammals exhibited at the Philadelphia Exposition in 1876 by Mrs. M. A. Maxwell, stating that "one was killed near Boulder by poisoning the carcass of a young horse which the panther had destroyed." [3]

Lynx canadensis Kerr. Canada Lynx.

The Canada lynx inhabits the Canadian zone forests of the higher mountains in Colorado, but in most sections its numbers are rapidly decreasing. The scattering records at hand indicate a former general distribution over the central and northern mountainous parts of the State, while a few are still left in the San Juan and La Plata Mountains of the southwest. At present the animal occurs chiefly in the heavy forests of the Park and Gore Ranges, the Rabbit Ear and Vasquez Mountains, and in southern Pitkin and Eagle Counties. It is said seldom to wander below 8,000 feet,[4] even in the heaviest snows of winter.

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[1] Bull. Essex Inst., VI, p. 53, 1874.

[2] See Coues, Birds of the Northwest, p. 224, 1874.

[3] Dartt, On the Plains and Among the Peaks, p. 218, 1879.

[4] A lynx reported to have been killed at Bayfield (6,500 feet) is an exception.

In 1905 lynxes were reported to be tolerably common in the mountains surrounding Middle Park. Alpert & Co., of Kremmling, purchased several skins taken in the winter of 1904–5 in the Williams Mountains, near the headwaters of the Williams Fork of Grand River; and Mr. Fred Selak, a fur buyer living near Coulter, annually handles a small number of skins from both the Grand Lake region and the Rabbit Ear Mountains. Lynxes are said to leave the higher mountains in February and March and come down into the forested country of the Grand Lake region, following the downward movement of the grouse and ptarmigan. The North Park slope of the Rabbit Ear Mountains is very good lynx country, and Mr. W. H. Graham, of Spicer, informed me that he and his brother usually trap from 10 to 15 each winter near the head of Arapahoe Creek. On the Medicine Bow Range and in the lodgepole pine forests east of the Laramie River lynxes are said to be uncommon. A few are reported by lumbermen on the Park Range along the headwaters of the Grand Encampment River, but little trapping appears to be done in that section. Dr. Kerneghan, of Steamboat Springs, has three fine lynx skins which were taken on the west slope of the Park Range during recent years, and states that in the winter of 1904–5 he saw tracks of a lynx in the aspen thickets on a mountain 2 miles south of Steamboat Springs at about 7,500 feet. Mr. J. R. Carron, storekeeper at Columbine, near Hahns Peak, usually buys two or three skins each year, but in 1906 none were brought in. A lynx taken in the Elk Head Mountains in the winter of 1905–6 was sold to Mr. Robert McIntosh, of Slater. According to Mr. A. G. Wallahan, a few are still found in the Williams River Mountains. Mr. Dall DeWeese, of Canon City, has a mounted specimen from the South Fork of White River, where he says lynxes were not at all uncommon some years ago. Mr. Frank Hayes, a taxidermist of Glenwood Springs, states that in the winter of 1903–4 he saw a lynx track at Mud Springs, on White River Plateau, and in 1905 purchased five skins which had been taken the preceding winter near Mount Jackson, at the northern end of the Saguache Range. While located at Aspen just previous to 1900, Mr. Hayes purchased six or eight lynx skins each winter, taken in the three following regions: Italian Mountain and Taylor Park, which are on the headwaters of Taylor River; region about Snow Mass Peak; and Independence Pass, at the head of the Roaring Fork of Grand River.

A very few lynxes were reported in 1907 in the mountains north of Pagosa Springs, and Mr. Don C. Coulson, of Bayfield, has handled a few skins from the high country in the Vallecito region, and also one skin which was taken in the winter of 1905 on a ranch adjoining the town of Bayfield (6,500 feet). Mounted specimens seen at Silverton and Ouray were doubtless killed in the neighboring mountains, but I could learn nothing definite concerning their history. Apparently this lynx is more numerous in the La Plata Mountains than in the San Juans. Mr. Steve Elkins, of Mancos, has trapped several in the spruce belt, and states that his hounds occasionally tree one while following a bear trail. This species is known as the snowshoe lynx in the La Plata Mountains.

A winter skin from Grand Lake, in northeastern Middle Park, is in the Biological Survey collection.

On the occurrence of *Lynx canadensis* in Park County, Allen says: "Represented as common. Saw skins of this species in the possession of hunters, taken in the vicinity of Mount Lincoln."[1] Warren mentions a skin which Mr. C. E. Aiken, of Colorado Springs, received from Beulah, and which is supposed to have come from either the Wet Mountains or the Sangre de Cristo Range.[2]

Lynx baileyi Merriam. Plateau Wildcat.

The bobcats of the lower parts of southern and eastern Colorado are referable to *L. baileyi*. The few Colorado specimens at hand do not permit an accurate outline of the distribution, but this wildcat appears to be most abundant in the Upper Sonoran zone. Along the eastern slope the species ranges a short distance into the foothills, and in the southwest is found commonly over an extensive area of rocky pinyon and juniper country. Bobcats are rare or entirely absent over much of the plains region east of the mountains, where the brush fringe and the few rocky ledges and bluffs along some of the streams furnish the only suitable environment. A few have been killed in the rocky canyons along Chief Creek, near Wray, Yuma County, during recent years, and in May, 1909, I saw tracks of a bobcat among the sandstone ledges near Tuttle, on the South Fork of Republican River. The animals have never been common in the Chimney Cliffs, northwest of Sterling, according to residents. The extensive juniper country in western Baca, Las Animas, and southern Otero and Bent Counties, however, is an ideal habitat, and bobcats are abundant throughout that region. They are reported common in the lower foothills from Fort Collins and Arkins south to Gardner, La Veta, and Trinidad, and in the southwest I have seen tracks at Arboles, Bayfield, on the Mesa Verde, near McElmo, East Paradox Valley, Sinbad Valley, south of Grand Valley, Plateau Creek, and on the desert north of Mack, lower Grand River Valley.[3] Bobcats reported from the cottonwood-fringed streams along the east side of the San Luis Valley are probably *baileyi*, as a specimen has been taken on Conejos River at the southern end of the valley.

Bobcats prey much upon rabbits, wood rats, and other small cliff-dwelling mammals, and in the open valleys sometimes subsist to a large extent upon prairie dogs and pocket gophers. Locally they are probably to be considered useful animals, the balance in their favor being due to the destruction of so many noxious rodents. On the other hand, wherever poultry is within reach they commit serious depredations, and near Pagosa Springs they are said to be very destructive to sheep.

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[1] Bull. Essex Inst., VI, p. 53, 1874.

[2] Mammals of Colorado, p. 258, 1906.

[3] Some of the above notes may refer to *L. uinta*.

Lynx uinta Merriam. Mountain Wildcat.

Although represented by specimens chiefly from the northwestern part of the State, this appears to be the species of the higher foothills and mountains generally, where it replaces *baileyi* of the lower foothills and canyons. It is a more robust animal than *baileyi*, with the cranium proportionally larger, and in size approaches *L. canadensis*, with which species it occurs at some of the higher elevations.

Bobcats are abundant in the rough pinyon and juniper country of Routt, Rio Blanco, and Garfield Counties. In 1906 the greatest numbers were reported northwest of Meeker and west of Snake River between Baggs Crossing and Escalante. Dogs are often used in hunting bobcats in the Meeker region, as the animals are readily treed after a short run. A series of skulls from near Meeker was collected by Mr. Theodore Roosevelt in 1901 and added to the Biological Survey collection.

Cottontails and snowshoe rabbits probably form most of the food of this species. Just below timberline in the Saguache Mountains near St. Elmo, and in other localities ranging between 10,000 and 11,000 feet elevation, I have followed the tracks of bobcats in the snow as they crossed and recrossed the dense willow copses in the trails of snowshoe rabbits, which they had evidently been hunting. In the lower part of its range, as in western Routt County, prairie dogs are next in importance on the summer bill of fare.

While walking along the railroad track near Rogers Mesa, in the North Gunnison Valley, in October, 1907, I had an excellent opportunity to watch the method by which the bobcat hunts prairie dogs. I was just emerging from a deep cut when I saw a large reddish bobcat at a distance of not over 40 feet. It was sneaking through the scattering greasewood bushes flat upon its belly, its short tail twitching nervously, and the excited chattering of prairie dogs on a neighboring flat showed that its approach had been noted by the alert animals. One large old prairie dog in particular, apparently the cat's intended victim, was seated at its burrow on the edge of the town, chattering in a bantering manner and appearing less frightened than the rest. The burrow was within leaping distance (about 10 feet) of the edge of the greasewood, and in making its approach the cat took advantage of every bush, stopping in the cover of each for a few moments. When it reached the last bush and was gathering itself for the final leap, the old prairie dog disappeared, but only just in time, as in another moment the cat landed on the rim of the burrow. Rapid, nervous jerks of the tail showed the cat's disappointment as it glared about in different directions. Up to this time my presence had not been noted, and not until I had thrown several stones did the cat see me, whereupon it bounded away across the dog town in long leaps. The section men working along the railroad stated that they often saw a cat near this colony, and it doubtless had its den in the neighboring rock ledges along the North Gunnison River, living easily on the fat denizens of the town.

On September 7, 1906, I saw two bobcats in the *Sarcobatus* brush along Snake River, a mile north of Lily, and tracks were often seen in the dry sandy beds of arroyos in the valleys of northwestern Colorado.

Canis occidentalis Richardson. Gray Wolf.

Gray wolves were formerly abundant over practically the entire State, except possibly the highest mountains, and were especially numerous on the eastern plains, where large bands preyed upon the buffalo. From this habit of hanging on the flanks of the large herds, they were generally known as buffalo wolves. The mountain animals are said to average much darker than those of the plains. Unfortunately there are no specimens available from the mountains to settle this point, but it is unlikely that two forms occur in the State. Wolves are still found in considerable numbers in North Park and in Routt and Rio Blanco Counties, where they kill a great many range cattle. A few are probably found throughout the mountains west of the main ranges, and small numbers are still present over the more unsettled parts of the eastern plains region, particularly in Baca and eastern Las Animas Counties, in the extreme southeast, where, in 1907 and in 1910, they were said to be common and to kill a great many sheep.

In 1906 wolves were common over most of Routt County, notwithstanding the bounty of $15 authorized by the local stock association, the additional $10 offered by the county, and the efforts of several professional wolf trappers employed by the association. The heaviest losses of stock were at that time incurred on the Iron Springs Divide and south of the Elk Head Mountains, although wolves were reported as unusually abundant in Browns Park on Green River. In the latter region the stock association hired three or four trappers to reduce their numbers, and about fifty were killed during the winter of 1905–6, the majority being trapped. Mr. John Criss, a trapper of many years' experience in the Snake River country, informed me that the wolves have been so persistently hunted, trapped, and poisoned that they will now rarely come to a scent of any description and seldom to a baited trap, while poisoning is unsuccessful. He has had the best success with traps set blind and placed in trails or near water holes in the badland country, several miles back from the Snake River Valley. A method of fastening wolf traps, used successfully by Mr. Criss in cold weather, seems worthy of mention. The trap is securely chained to a bush or stake at the edge of a steep-walled gully or wash so that the wolf in its struggles to escape will leap over the edge and hang half suspended and helpless, unable to regain the top of the bank. Wolves thus trapped in severe weather usually freeze to death in a few hours.

An impression prevails among stockmen in northwestern Colorado that wolves retire to the mountains to whelp, but I find no evidence to support this theory.[1] In Dixon, Wyoming, I saw a nearly adult black wolf in captivity, which had been captured as a cub in a den among the Snake River bluffs, 20 miles west of Baggs Crossing, in the spring of 1905. This individual was kept in a large cage in the back yard of its owner in Dixon. A boy of 3 years was petting and stroking its head through the bars, and the wolf's every movement betokened its pleasure in the companionship of the little fellow. All playfulness immediately left it, however, on the approach of a man, when the wild, untamable wolf nature was revealed in bared fangs, curling lips, and glaring eyes. The mother of this wolf was gray, as was also one of the three cubs captured in the den. According to trappers both black and white wolves occur, but white ones are said to be extremely rare.

In the Lily Park region, on the lower Bear River, Mr. F. C. Barnes states that wolves were numerous until 1902, but during the two years following a trapper named Snyder killed 61. Since that time few cattle have been killed in that section by wolves. In 1905 wolves were reported in considerable numbers in the White River country, particularly in the valley of the Piceance, but were scarce near Rangely in 1906. During the winter of 1904–5, 7 were killed out of a band of nearly 25 which was ranging in North Park, but in 1906 wolves were reported scarce in that region. I often saw wolf tracks in the trail as we traveled through the parks on the divide east of the Laramie River, in August, 1906, and the animals were then said to be very troublesome in that section. Tracks were observed as high as 10,000 feet. Wolves are of rare occurrence in Middle Park, but two are said to have been seen on the stage road near Coulter during the winter of 1903–4, and another near Grand Lake the following winter. One of a band of three which ranged on the head of Willow Creek, in the northern part of Middle Park, was killed early in the summer of 1906. In Egeria Park and on the Gore Range wolves are reported as of rare occurrence. They were uncommon over most of southern Colorado in 1907, particularly in the San Luis Valley, the Pagosa Springs region, and in Montezuma County, where they are considered very rare. According to Mr. Steve Elkins, of Mancos, none have been reported in that region since the winter of 1904–5, when four or five were seen between Cortez and Mancos. In the region contiguous to the upper waters of the Vallecito and Los Pinos, in northeastern La Plata County, they are said to be increasing during the past few years, but no serious damage is reported. Forest Supervisor E. W. Shaw, of Durango, states that a band of 12 was seen near Vallecito in the winter of 1906–7. A few wolves were reported from the western part of San Miguel and Montrose Counties, a large male having been killed in the Dry Creek Basin in the winter of 1906–7, and a female with four whelps was stated to be ranging the same region in the summer of 1907. According to Warren, wolves were reported in the fall of 1906 to be increasing on the Black Mesa, south of the West Elk Mountains.[1]

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[1] On this point, see Bailey, Wolves in Relation to Stock, Game, and the National Forest Reserves, Bull. 72, U. S. Forest Service, 1907.

Dr. A. K. Fisher reported wolves as common near Las Animas in 1892 and in the Estes Park region in 1894, and according to Streator, numbers were to be found the same year on the Republican River, north of Burlington, and in the vicinity of Olney. Prof. Lantz reports that a band of three was often seen in the vicinity of Hugo during the winter of 1904–5. The rough canyon country of Las Animas, Baca, and southern Otero and Bent Counties was in early days resorted to by large numbers of wolves for breeding purposes, and many still breed in that region.

Ranchmen living in northwestern Logan and northeastern Weld Counties stated in the summer of 1909 that wolves were very scarce in that section, only one being known to inhabit the Horsetail Basin south of the Chimney Cliffs. This is said to be a female, and is supposed to be the mother of eight whelps which were dug out of a den in the rough country on the head of Deadman Creek, 20 miles northeast of Avalo, in the spring of 1909. In the spring of 1908 a litter of six or seven was dug out in the same canyon, two of which were taken alive to Nebraska, and another one was kept on a ranch north of Sterling until it became vicious, when it was killed. In 1908 a cowboy named Frank Jordan is stated to have roped an old male wolf on the open plains in the same vicinity.

Allen states that "*Canis lupus*" was comparatively scarce in Park County in 1871, although formerly abundant there.[2] As "*Cani occidentalis*" Trippe records the wolf as an early inhabitant of Clear Creek County.[3]

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[1] Further Notes on Mammals of Colorado, p. 82, 1908.

[2] Bull. Essex Inst., VI, p. 54, 1874.

[3] See Coues, Birds of the Northwest, p. 224, 1874.

Canis lestes Merriam. Mountain Coyote.

This large, dark, richly colored species occurs more or less abundantly throughout the mountains, ranging from the lower foothills to above timberline. Its habits are not unlike those of the coyotes of the plains and valleys, but its prey is somewhat different, consisting chiefly of dusky grouse, cottontails (*Sylvilagus n. pinetis*), and snowshoe rabbits, and including also many deer and fawns. A small band of these coyotes hunting together has even been known to kill several mountain sheep which had been shut into a small pocket by an avalanche.[1] Fawns are of course preyed upon in summer and early fall, but the adult deer only in winter when the crust will sustain the coyotes but not the deer. I am informed by forest rangers who have seen coyotes pursuing deer in this manner that a band of five or six will overtake a deer and hamstring it very quickly on a weak crust of snow. Many calves also are killed by coyotes in the mountain parks, and in certain localities it is almost impossible to raise chickens and turkeys because of their depredations.

At the Medano Springs ranch, in the San Luis Valley, coyotes were unusually abundant and destructive in October, 1907. Numbers were seen each morning on the broad hay meadows west and north of the ranch buildings, where they mixed freely with the cattle, and evinced little fear of man unless he carried a gun. Several were noted lying quietly on the tops of haystacks, from which they could detect anyone approaching. During the day one was in almost every extensive weed patch or growth of rank marsh grass, ready to pick up the turkeys and chickens which strayed too far from the ranch buildings. On the meadows near Saguache coyotes have been seen catching meadow mice and playing with them like a cat. In the yellow pine forests of Archuleta County coyotes are very destructive to sheep, notwithstanding the night fires kept burning by the Mexican herders.

On the Saguache Mountains near St. Elmo I saw many fresh coyote tracks in the snow above 11,000 feet, October 9, 1907. One track followed a high ridge above timberline, at 12,500 feet. I have noted tracks also on the summit of Berthoud Pass, and coyotes are commonly reported on Grays Peak and in other sections of the high mountains.

Canis nebracensis Merriam. Plains Coyote.

The coyotes of the eastern plains region are referable to *C. nebracensis*, the type of which is from Johnstown, Nebraska, and specimens from the sage plains of North Park and Routt County seem nearest this species. This light-colored coyote inhabits the lower levels, being replaced in the higher foothills and mountains by *C. lestes*, a much darker animal.

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[1] See note under *Ovis canadensis*, p. 64.

On my trips through the northern parts of the State I found coyotes most numerous on the extensive sage plains bordering the Snake and Bear Rivers, in Routt County, although they are abundant in North Park and at many points east of the mountains, especially in the Wray region and northwest of Sterling. Wherever found in any numbers in settled districts, coyotes kill a great many sheep, young calves and pigs, and much poultry. They are heartily hated by stockmen and farmers alike, who never lose an opportunity to kill them. The stock association in Routt County was offering a bounty of $1 on coyotes in 1906, but most of the professional wolf trappers claimed that this was not sufficient remuneration, and hence coyotes were increasing rapidly at that time. A few trappers, however, were at work on coyotes in the Snake River region in 1906. Mr. John Criss, of Baggs Crossing, Wyoming, who makes his winter headquarters near Sunny Peak, is said to trap and poison about 200 coyotes each winter. While I was traveling down the Snake River Valley coyotes were numerous and bold, and were heard at all hours of the day and night.

Coyotes partly compensate for the damage to live stock and poultry by catching great numbers of noxious rodents, such as pocket gophers, prairie dogs, ground squirrels, rabbits, and mice—particularly meadow mice, of which they appear very fond. One noted in a hay meadow near Lake John in the western part of North Park, August 9, was so busy hunting for meadow mice in the rank grass that it appeared oblivious of the presence of eight teams at work in the field and did not become alarmed until my companion shot at it.

Mr. W. O. Potter, of Avalo, states that once on the plains of northeastern Weld County he saw an eagle flying heavily with a captured prairie dog, and under the eagle a coyote following along with the apparent intention of pouncing on the quarry when the eagle became wearied and alighted to eat it.

Canis estor Merriam. San Juan Coyote.

Doubtless all the coyotes inhabiting the warm Upper Sonoran deserts and valleys of southwestern Colorado should be referred to *C. estor,* which was described from Noland's ranch, San Juan River, Utah. The Book Cliffs appear to separate this small pale desert species from *C. nebracensis* of the Routt County sage plains.

Coyotes are abundant near Mancos, on the Mesa Verde, in the McElmo Valley, in the region of the lower San Miguel and Dolores Rivers, and in the lower Grand Valley. The chief damage appears to be to sheep and poultry, although in the McElmo Valley they are said to eat a great many watermelons and cantaloupes on the vines. A coyote seen near McElmo June 20 was small and light-colored, and in all the lower valleys the small pale coyotes are distinguished locally from the large dark animals of the mountains.

Vulpes macrourus Baird. Western Fox.

This species, which is larger and darker than the eastern red fox (*V. fulvus*), is common in the Colorado mountains. It is subject to a wide range of color variation, covering the red, cross, silver-gray, and very rarely the black phase. The proportion of dark individuals is much greater than with *fulvus*. This fox is found at the present time chiefly in the forest belt of the higher mountains, above 8,000 feet. Its distribution in this region is general, and in some sections considerable numbers are present. I have no data respecting its range on the plains in early days, but, judging from its former occurrence on the plains of Nebraska and Wyoming, it was probably present sparingly over eastern Colorado. In the canyon country in parts of southwestern Colorado this fox is fairly common as low as 6,000 feet. The species yields a fur of considerable value and is extensively trapped in winter.

In 1905–6 it was reported as tolerably common in the Rabbit Ear, Williams, and Williams River Mountains, on the Front, Park, and Medicine Bow Ranges, and on the White River Plateau. Small numbers were reported on the Gore Range and in the mountains around Mount Cullom and Zenobia Peak, in western Routt County. The red or tawny phase appears to predominate in the Elk Head Mountains, since in a series of 17 skins handled by Mr. Robert McIntosh, of Slater, in 1906, 15 were red and only 2 were of the cross phase. Mr. L. Wallace, of Granby, Middle Park, states that the majority of skins taken in the Grand Lake region are cross foxes. According to Warren, four out of six foxes killed near Crested Butte, Gunnison County, were of the cross phase.[1] Foxes were reported in small numbers in the mountains of Clear Creek County in 1905. At the Stevens Mill, on Mount McClellan, I learned of a young fox which had been captured in the spring by Italian miners on Grays Peak, at about 12,000 feet, and kept in confinement for a time. Skins which Loring saw at Grand Junction in 1893 probably came from the Grand Mesa region, and during the same year he reported foxes from Estes Park.

In the southern and southwestern mountains this fox appears to have fully as wide a distribution as father north. In the San Juan Mountains north of Pagosa Springs and Vallecito the cross phase is most common, according to the best-informed hunters and trappers. There are a few silver-grays, and very rarely a black fox is seen. Cross foxes are said to predominate also in the Saguache Mountains near St. Elmo, and a black fox has been seen near Tin Cup. Foxes are reported in small numbers from the Cochetopa Hills, La Plata Mountains, near Lone Cone in the San Miguel Mountains, and the Uncompahgre Plateau. Mr. Case, a trapper, is said to have taken

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[1] Mammals of Colorado, p. 259, 1906.

19 foxes along the Dolores River Canyon between the mouths of Disappointment and Paradox Creeks during the winter of 1906–7. Of these, several were cross foxes, while 2 were graded by the furrier as silver-cross and brought $50 apiece. The western canyon country seems to be especially frequented by foxes, although the altitude is low. Both silver-gray and red foxes are reported sparingly from the mountains on each side of the Wet Mountain Valley, and a black fox is said to have been seen at the eastern base of the Sangre de Cristo Range, west of Westcliffe, many years ago. Mr. E. W. Scott, of La Veta, has seen a fox skin from Veta Pass, and several silver foxes are stated to have been trapped on Sierra Blanca during recent years.

At Ward, Boulder County, in June, 1893, Loring found a fox den among the rocks on a mountain side, and collected the female, whose fur was badly worn, and four half-grown young. Scattered around this den was a varied assortment of bones (including a fish bone), chicken wings, bird feathers, and a pair of old buckskin gloves. Each time the den was approached, the old fox barked and ran away a few rods in an attempt to lure the intruder from its vicinity.

Allen states that in a series of 40 winter skins which he examined at Montgomery, Park County, in 1871, nearly half were cross and one individual was black.[1] The only published color description of the black phase of *V. macrourus* relating to a Colorado specimen appears to be that given by Coues and Yarrow of a melanistic skin from Los Pinos (now Bayfield), La Plata County, as follows:[2]

"A specimen, which we are inclined to refer to this species on account of its great size and especially large tail, is jet black all over, with a pure white tip to the tail; one of the finest examples of complete melanism we have seen. The purity of the black is only interrupted by a slight gray grizzle on the face and rump."

Warren has published the description of a dark silver skin from Cumbres Pass, Conejos County, in the Colorado Museum of Natural History.[3] Coues says there were many specimens of this fox in Mrs. M. A. Maxwell's mounted collection of Colorado mammals which was on exhibition in Washington during the winter of 1876–77.[4]

Vulpes velox (Say). Kit Fox; Swift.

[*Canis*] *velox* Say, Long's Exped. to Rocky Mts., I, p. 487, 1823. Type from South Platte River (in Logan County?), Colorado.

The small swift or kit fox was formerly common over the plains of eastern Colorado, but has become rare in most sections. In 1892 Dr. A. K. Fisher says it was reported tolerably common in the vicinity of Sterling (near type locality), and Mr. Edward A. Preble states that it was considered very rare in the region about Loveland in 1895. On the plains of Boulder County very few, if any, remain at the present time. The only record for this region in recent years appears to be that of two which were killed on the farm of Mr. Samuel Hays, 3 miles northeast of Boulder, in 1903. Mr. W. H. Graham, of Spicer, says he has met with this fox but once during a long residence in North Park. In 1893 he shot two near their den, which was on an open sandy slope near Arapahoe Creek, in the southern part of the park. Prof. Lantz found a dead swift on the prairie near Cheyenne Wells in 1903, and was informed that they were not uncommon in that region. In 1907 swifts were reported as common on the plains of Baca County and also in southern Bent and Prowers Counties. In all probability they are now more common in southeastern Colorado than elsewhere in the State. A few were reported in 1909 on the eastern end of the Arkansas Divide and near Tuttle on the South Fork of the Republican River. There is said to be a colony of them near Keota, southwest of Pawnee Buttes, in northeastern Weld County.

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[1] Bull. Essex Inst., VI, p. 54, 1874.

[2] Expl. W. of 100th Mer., V, p. 55, 1875.

[3] The Mammals of Colorado, p. 238, 1910.

[4] Dartt, On the Plains and Among the Peaks, p. 219, 1879.

Urocyon cinereoargenteus scotti Mearns. Gray Fox.

The range of the gray fox in Colorado is in the juniper and pinyon foothills on both sides of the mountains, chiefly in the Upper Sonoran zone. On the east side of the mountains it is known from Loveland and the Estes Park region, the foothills from the Arkansas Valley southward, and the rough country of Las Animas, southern Bent, and western Baca Counties. (See fig. 26.) It is more common in the rough pinyon country of western and especially of southwestern Colorado, where it ranges north sparingly to the Escalante Hills in western Routt County. Specimens examined from both sides of the mountains are referable to this form.

Most of my notes are from west of the mountains. Mr. A. G. Wallahan, of Lay, reports seeing two skins of gray foxes in Lily Park in March, 1905, and Mr. F. C. Barnes, of Lily, killed one near there the following winter. Members of a railroad surveying party working in the Yampa Canyon of Bear River during the winter of 1904–5 are reported to have killed several gray foxes. In the Escalante Hills, north of Bear River, as well as in the southwestern counties, the animal is known as the pinyon fox. Ranchmen report an occasional gray fox at Rangely, in the White River Valley, and also at Mack, in the lower Grand River Valley. A few are said to have been killed near Rifle during the past few years, and at Grand Junction in 1893 Loring saw the skin of one which had been killed in Mesa County.

The gray fox reaches its greatest abundance in the region from Montezuma County north to the San Miguel River. Mr. Steve Elkins states that in the Mancos region they are usually found in the pinyon belt, but occasionally also among the yellow pines at the west base of La Plata Mountains. He often hunts foxes with dogs and kills a good many in this manner. A ranchman living on McElmo Creek, in western Montezuma County, is said to have caught 15 gray foxes in one winter. I found a den near McElmo in June, 1907, which had apparently just been vacated by a family of foxes. It was in loose shaly earth near the summit of a bare hill in plain view of a house and near a traveled road. There were a number of entrances to this den several rods apart, and the ranchman living near by stated that he often saw the old fox and three young ones frisking about during the day. This fox is reported as common in the pinyon country bordering the lower San Miguel and Dolores Rivers, and Mr. C. H. Smith, of Coventry, traps a number each winter along the Naturita Canyon just back of his ranch. In the Uncompahgre Valley near Montrose these foxes are termed swifts. A mounted specimen which I saw at Montrose was killed within 3 miles of that point and a number of skins and rugs seen in stores there indicate that gray foxes are common in that section.

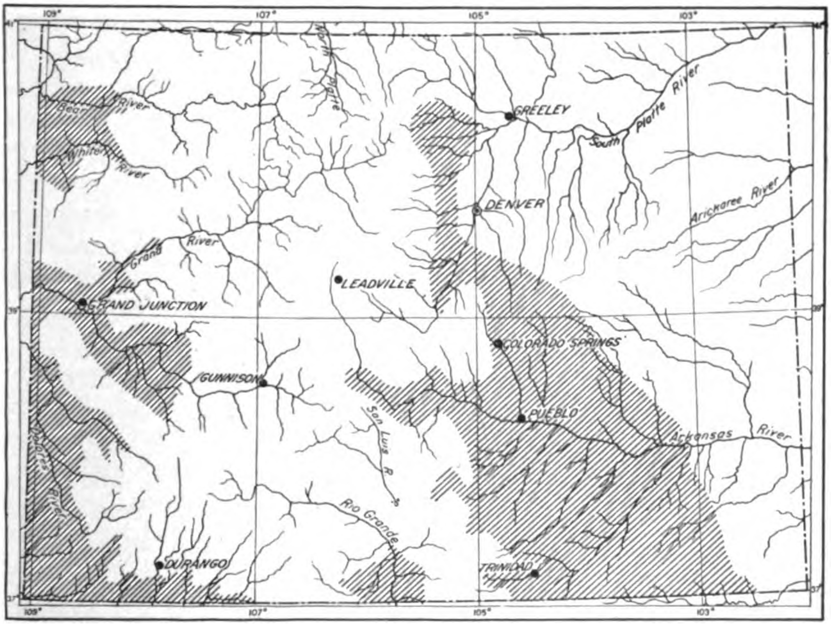

FIG. 26.—Distribution in Colorado of gray fox (*Urocyon c. scotti*).

Mr. J. W. Frey, of Salida, has a mounted specimen taken in that vicinity and says a number have been killed in the pinyon hills bordering the upper Arkansas Valley during recent years. In Huerfano County gray foxes are found in the pinyon country at both Gardner and La Veta, and Mr. E. W. Scott, of La Veta, has a mounted specimen from the upper Cucharas Valley. A mounted specimen seen at Buffalo, Jefferson County, was probably killed in the neighboring hills. In 1904 Bailey reported a few gray foxes among the lava buttes east of Antonito, in the southern end of the San Luis Valley, but I could learn of none in the northern and central part of the valley in 1907. Loring saw two gray foxes among the rocks in Estes Park in 1893 and shot one of them.

Mephitis hudsonica Richardson. Northern Plains Skunk.

This species, the largest of the Colorado skunks, comes into the State from the north and inhabits chiefly the higher mountainous sections. It is not known to occur south of Colorado Springs and Salida. Unfortunately the specimens examined represent very few localities, and therefore the distribution can not be accurately given. At Arkins, Larimer County, judging from a large series of skulls, *M. hudsonica* and the long-tailed skunk of the plains, *M. m. varians*, occur in about equal abundance, apparently without intergradation.[1] The ranges of the two species may overlap over a considerable area along the lower eastern foothills, since Warren has taken both at Colorado Springs. A series ot 19 skulls from Arkins and 1 skull from Spicer, North Park, in the Biological Survey collection, are referable to *hudsonica*. Specimens in the Warren collection from Colorado Springs and Salida are doubtfully referred to this species, although they are by no means typical.

All the records of skunks secured in the mountains of northern and central Colorado are tentatively referred to *hudsonica*. In 1905 and 1906 I noted tracks near Coulter, on Grand River above Kremmling, and along the upper Snake River at Honnold. A den was found among the rocks on the north slope of the Elk Head Mountains, southeast of Slater, and the remains of a skunk were seen at Hayden, on the upper Bear River. Skunks were reported in Middle, North, and Egeria Parks, and in the vicinity of Meeker and Glenwood Springs. In 1893 Loring found skunks common in Estes Park, where they were said to kill much poultry.

Allen found skunks common in Park County in 1871, and says they range above timberline in that section.[2]

Mephitis mesomelas varians Gray. Long-tailed Skunk.

The long-tailed skunk is found on the eastern plains, and also enters the State from the south in the Rio Grande Valley. It occurs at a few points along the edge of the foothills with *M. hudsonica*, as already stated, but over the lower eastern part of the State appears to be the only large skunk present. The skunks reported at Bradford, Gardner, and La Veta, in the foothills of Huerfano County, and also along the pinyon-clad foothills bordering the San Luis Valley, are doubtless *M. varians*. This species can be readily distinguished from *M. hudsonica* by its smaller size, relatively longer tail, and by the usual absence of the pencil of white hairs at the tip of the tail.

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[1] See Howell, N. Am. Fauna No. 20, p. 25, 1901.

[2] Bull. Essex Inst., VI, p. 54, 1874.

In addition to a large series of odd skulls and several skins from Arkins, Larimer County, the Biological Survey has specimens of *varians* taken at Loveland, Sterling, Canon City, Chivington, and Antonito. The Merriam collection contains a female from Boulder County. Howell records a specimen from Conrow (Chaffee County), and two from Costilla County.[1] A skull in the National Museum from Cripple Creek may have been taken in the low Oil Creek Valley west of that point, as *varians* is not known to occur at the higher elevations or much above the upper edge of the Upper Sonoran zone. Specimens from Colorado Springs and from Gaume's ranch and Springfield, Baca County, have been identified by the Biological Survey for Warren, and he has recently recorded the species from Wray, Yuma County.[2]

The food of skunks consists chiefly of insects and the smaller rodents. Near Higbee, Otero County, Prof. Lantz found them feeding extensively upon the larvæ of tiger beetles (*Cicindela*), which they dug out of the sand on the banks of Purgatory River.

Mephitis mesomelas estor Merriam. Arizona Skunk.

The large skunks reported in the warm southwestern valleys, from Grand River southward, are probably *M. m. estor*, since three specimens from the pinyon country around Coventry are referable to this form. Although very generally reported, the large skunks appear to be less common in most sections of the southwest than the small spotted species (*Spilogale*). Tracks of skunks were seen along Plateau Creek, near Tunnel, Mesa County; in the mud along McElmo Creek, Montezuma County; and along an irrigation ditch at Nucla, western Montrose County. Loring saw the tracks of a skunk at Silverton.

The distribution and relationships of the skunks of western Colorado are imperfectly known, and additional specimens from many localities in this region are greatly desired. It is not likely that *estor* occurs north of the Book Cliffs. The skunks of the Routt County sage plains are probably *M. hudsonica*, but there are no specimens at hand from that region.

Spilogale interrupta (Rafinesque). Prairie Spotted Skunk.

This handsome dark species of spotted skunk ranges a short distance into the central eastern part of the plains region of Colorado, the only Colorado specimen known being one taken at Wray, Yuma County, by Warren, and identified by the Biological Survey. While at Wray in December, 1907, I was informed that small numbers of spotted skunks frequented the sandstone bluffs along the south side of the Chief Creek Valley.

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[1] N. Am. Fauna No. 20, p. 32, 1901.

[2] Further Notes on Mammals of Colorado, p. 83, 1908.

Prof. Lantz states that spotted skunks are reported common in the vicinity of Hugo, Lincoln County. The specific identity of the Hugo animal is uncertain, since there are no specimens available from that section, and since *S. tenuis*, the species found along the eastern foothills, probably ranges a short distance out on the plains in the region of the Arkansas Divide. The prairie spotted skunk may be distinguished from the other forms occurring in the State, *S. tenuis* and *S. g. saxatilis*, by its larger size and darker coloration, the white spots and bars being at a minimum. The tail also is usually wholly black except the white tip.

Spilogale tenuis Howell. Rocky Mountain Spotted Skunk.

Spilogale tenuis Howell, Proc. Biol. Soc. Wash., XV, p. 241, Dec. 16, 1902. Type from Arkins, Larimer County, Colorado.

Little is known regarding the range of this species, all the information at hand indicating a scattering distribution in both the Transition and Upper Sonoran zones among the lower foothills at the eastern base of the mountains. Most of the records are from north of the Arkansas Divide, in Larimer, Boulder, Jefferson, and Douglas Counties. It has been collected in northeastern New Mexico, however, and no doubt ranges across the entire width of Colorado along the eastern foothills.

In June, 1905, I saw the tracks in a dry gulch a mile or two southwest of Golden, while at Arkins (the type locality) the animals were reported tolerably common in the valleys below 6,000 feet. Mr. Berry, a ranchman, is said to have killed one a mile southwest of Arkins in July, 1906. Mr. Vernon Bailey caught one among the rocks in the foothills 2 miles west of Boulder in October, 1903, but it escaped. Several specimens have been collected at Boulder by Mr. R. T. Young.[1] Warren records a specimen from Sedalia, Douglas County, in the collection of Colorado College,[2] and has an immature specimen from Colorado Springs in his own collection. A specimen from Estes Park is in the American Museum of Natural History, and one from Loveland is in the National Museum.

In 1907 I was informed by Mr. William King, of the Medano Springs ranch, near the San Luis Lakes, that he has seen a number of spotted skunks among the foothills on the San Luis Valley side of the Sangre de Cristo Range, near Mosca Pass. The species may have crossed the mountains through this low pass, as it is reported present in the Muddy and Huerfano Valleys, on the east side of the range. In the rough juniper country of Las Animas and western Baca Counties, in the extreme southeast, spotted skunks are reported much more common than *Mephitis*.

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[1] Proc. Acad. Nat. Sci. Phila., p. 406, 1906.

[2] Further Notes on Mammals of Colorado, p. 83, 1908.

Spilogale gracilis saxatilis Merriam. Great Basin Spotted Skunk.

The small spotted skunks of the warm Upper Sonoran valleys west of the Continental Divide are referable to *saxatilis*, although specimens from Coventry, in western Montrose County, are not typical. Over most of their range *Mephitis* occurs with them but in smaller numbers. The spotted skunks are much more active and agile than the large ones and readily climb pinyons and junipers. Rock ledges along canyons are much frequented by them.

None were collected in northwestern Colorado during 1905 and 1906, but they were reported as occurring in all the valleys entering the State from the west. According to Mr. John Criss, a wolf trapper with headquarters at Baggs Crossing, Wyoming, the spotted skunk is tolerably common on the lower Snake River, where it is the only skunk present. It occasionally gets into his wolf traps in winter, and he has trapped it as far east as the old Edwards sheep camp, 35 miles below Baggs Crossing. Spotted skunks are reported common at Escalante, Routt County; and in Lily Park, at the confluence of the Snake and Bear Rivers, ranchmen often find them beneath houses and in cellars. At Rangely, in the valley of White River, they are said greatly to outnumber the large striped skunks. They are reported also from the upper White River country, according to Felger.[1] The range of *saxatilis* probably extends in the Grand Valley as far east as Glenwood Springs. I occasionally heard of it west of Rifle, Garfield County, and Mr. Fred Baker, a taxidermist of Glenwood Springs, reports that he has handled several skins taken during the past few years in the Grand Valley east of Newcastle.

In 1907 spotted skunks were reported as common and greatly outnumbering *Mephitis* in the Mancos and McElmo Valleys (Montezuma County), in the region of the lower Dolores and San Miguel Rivers, and at Coventry. A few were reported also in the vicinity of Bayfield, La Plata County. At Ashbaugh's ranch, in the McElmo Canyon, a female got into a small trap which I had baited with a piece of potato and set among the rocks for wood rats. Mr. C. H. Smith has caught a number of these skunks in the pinyons back of his ranch at Coventry, one being taken in a tree trap set for gray foxes 3 feet up on the trunk of a large pinyon standing on the upper rim of Naturita Canyon. A male in the Biological Survey collection was taken by Howell among rocks 2 miles south of Grand Junction.

Taxidea taxus (Schreber). Badger.

The badger is one of the most widely distributed mammals in the State, occurring throughout the plains and deserts of the lower parts, and in the mountains ranging with more or less regularity nearly to timberline. Two forms may be present, there being a possibility of

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[1] Univ. of Colo. Studies, VII, No. 2, p. 145, 1910.

T. berlandieri in extreme southern and southwestern Colorado, but this can not be determined from the scanty material now available.

The numerous holes which badgers are continually digging on the plains in search of their rodent prey make horseback riding in certain sections somewhat hazardous. Aside from this, however, badgers are most beneficial mammals, since their food consists chiefly of prairie dogs, ground squirrels, and other noxious rodents, which they secure by digging down to the nests. On the sage plains and in the mountain parks of northwestern Colorado the badger feeds extensively upon the white-tailed prairie dog (*Cynomys leucurus*), the Wyoming ground squirrel (*Citellus elegans*), and pocket gophers (*Thomomys*). Badgers are voracious, and one animal will open up a large number of burrows in a night.

In 1905 and 1906 badgers were abundant in Middle, North, and Egeria Parks and in the valleys of the Bear, Snake, Green, White, Grand, and Eagle Rivers. A specimen shot among the White River bluffs, 20 miles east of Meeker, was running up the steep side of a canyon. One was found dead in the trail near the head of Grand Encampment River, on the Park Range, at an elevation of 10,000 feet. Warren mentions that he killed a specimen in Gunnison County at about 11,500 feet.[1] In 1907 badgers were reported common in southern and southwestern Colorado, where they prey largely upon prairie dogs (*Cynomys gunnisoni*). Loring secured a specimen near Cochetopa Pass, and Bailey reports them common in the Rio Grande Valley near Antonito. The burrows are common on the South Park plains east of Como, at 9,800 feet. Other members of the Biological Survey have found badgers common at Sterling, Loveland, Estes Park, Las Animas, Burlington, and Olney.

Lutra canadensis (Schreber). Otter.

Otters seem to have been always rare in the State, although the reason is not apparent. The country is well watered, and nearly all the lakes and streams are well stocked with fish and should offer a satisfactory habitat. My notes refer for the most part to western Colorado, and the otter of that region may be the southwestern form described by Rhoads as *L. canadensis sonora*. This can not be confirmed at present, as there are no specimens available.

During the winter of 1902–3 four otters were trapped on Snake River within a few miles of Slater, Routt County, by two trappers, Messrs. James Coates and James Parsons, living at Slater. In 1905 Mr. A. G. Wallahan, of Lay, Routt County, reported a few still present in the Yampa Canyon on Bear River.

Warren thinks the rarity of otters in mountain streams may be due to the "freezing of their sources of supply" in winter.[2] There are, however, many fine lakes throughout the mountains well stocked with fish and furnishing a most favorable environment for otters. The following records are given by Warren (l. c.): "Grand Junction and Big Dolores River, a few (Dr. E. F. Eldredge); Platte River, east of Greeley, one specimen (A. E. Beardsley); Julesburg, occasional (H. G. Smith)." In a more recent publication Warren gives the following data: "Mr. Henry Lehman, of Grand Lake, tells me there are a few otter in the Grand River, in Grand County. Herman W. Nash writes me that friends of his saw two in the Gunnison River, near Sapinero, in August last.[1] Felger records this species from the White River Valley on the authority of Ball.[2] Trippe records the otter from Clear Creek County;[3] and Coues mentions a specimen from Boulder County, which he saw in the collection of Mrs. M. A. Maxwell.[4] A skull in the National Museum is from Pueblo.

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[1] Mammals of Colorado, p. 261, 1906.

[2] Ibid, p. 265, 1906.

Lutreola vison energumenos (Bangs). Mink.

Minks occur in varying abundance on nearly all the larger streams of Colorado, and in the unsettled parts the skins bring considerable revenue to trappers. They are more abundant in the mountains than on the plains, and are especially common in Middle and North Parks, where their fondness for poultry makes chicken raising most unsatisfactory on many ranches near streams. The minks of the higher mountains yield a rich dark fur of good quality, but the plains animal is said to be considerably paler and consequently less valuable. As no specimens of minks from the eastern part of the plains region are at hand, it is not certain that they are of the same form as the mountain animal, but specimens from along the eastern base of the foothills are identical with those from the higher mountains.

A female which I collected on Boulder Creek, 5 miles west of Boulder, in June, is very dark, the fur being full and heavy, even at that late date. Other dark minks were observed on McIntyre Creek, Larimer County, and in the Elk Head Mountains, during August, and I saw two rich dark skins from the upper Los Piños in a store at Bayfield. Mink tracks were observed on Snake River, at Honnold; on Bear River, at Hayden and Lily; on White River, at Meeker and Rangely; on Grand River, at Glenwood Springs, Kremmling, and Hot Sulphur; on Plateau Creek, near Tunnel; on Good Spring Creek, near Axial; and on Green River, near Ladore. Minks were reported abundant on the Cucharas River at La Veta and on the San Juan River at Pagosa Springs. Specimens from Loveland, Cochetopa Pass, Pagosa Springs, and Arkins (Larimer

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[1] Further notes on Mammals of Colorado, p. 84, 1908.

[2] Univ. of Colo. Studies, VII, No. 2, p. 146, 1910.

[3] See Coues, Birds of the Northwest, p. 224, 1874.

[4] Fur-bearing Animals, p. 312 (footnote), 1877.

County) are in the Biological Survey collection. Others in the Warren collection from Crested Butte and Colorado Springs have been examined by the Biological Survey.

In 1871 Allen found minks common along the streams of Park County as high as 10,000 feet.[1]

Putorius nigripes Aud. and Bach. Black-footed Ferret.

This rare and little known mammal has been recorded from a number of localities on the plains of eastern Colorado (see fig. 27), but here, as elsewhere over its range, its numbers are small. Usually it is found in prairie-dog towns, where it takes up its abode in an abandoned burrow, and from this convenient base preys upon the defenseless inhabitants of the colony. These ferrets are most beneficial mammals, because their prey consists largely of prairie dogs.

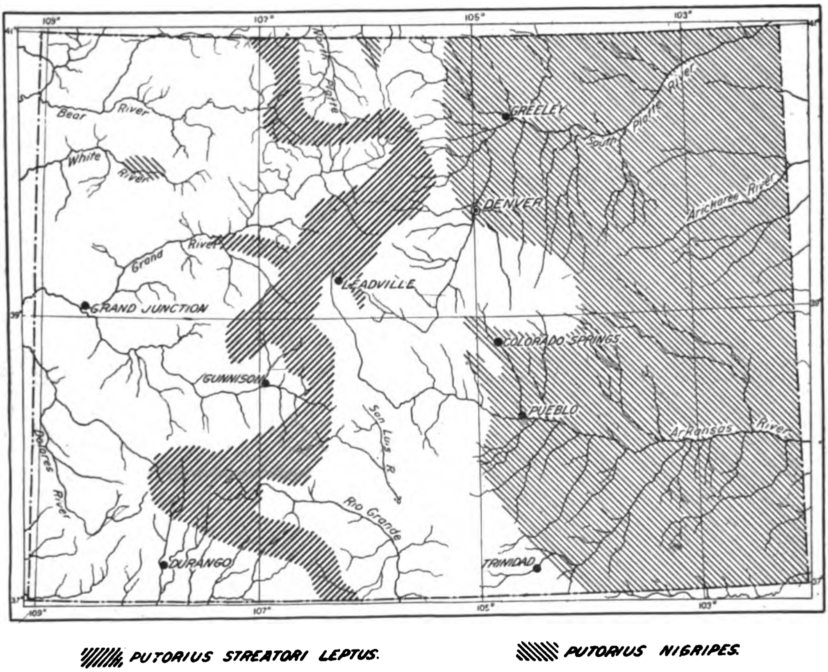

FIG. 27.—Distribution in Colorado of dwarf weasel (*Putorius streatori leptus*) and black-footed ferret (*P. nigripes*).

In December, 1894, black-footed ferrets were reported to Streator as present, but rare, at three points in the Arkansas Valley: Olney, Otero County; Arlington; and Chivington, Kiowa County. Prof. D. E. Lantz heard of a very few in the region about Hugo in 1905, where they are known as prairie-dog ferrets. In 1907 I heard of this species in the dog towns of Baca and southern Prowers Counties, and it seems to be more generally known in that region than in other sections on the plains. I did not hear of ferrets in the prairie-dog country of northwestern Colorado, but Warren records two mounted specimens at Meeker, said to have been taken near there, and mentions a specimen from the Laramie River, 12 miles south of the Wyoming boundary, in the University Museum at Boulder.[1]

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[1] Bull. Essex Inst., VI, p. 54, 1874.

Two specimens in the Warren collection indicate a most remarkable vertical range for this plains mammal. Warren says: "One specimen in my collection came from Divide, Teller County, at an elevation of 9,800 feet, another was found dead in Lake Moraine, El Paso County, altitude 10,250 feet. It is a mystery how the animal came there, and when skinned there were no marks on its body to indicate the cause of death. In the spring of 1904 C. E. Aiken mounted one which came from near Clyde Station, El Paso County, altitude 9,440 feet." [2]

Others have been recorded by Coues,[3] as follows: A specimen taken in the Cache la Poudre Valley by Dr. Law and brought to Washington by Dr. Hayden; another reported by Dr. Hayden as having been kept in confinement at Greeley for a considerable period; and two or three specimens procured by Mrs. M. A Maxwell in the vicinity of Denver and forming a part of her exhibit of Colorado mammals at the Philadelphia Exposition. All the above ferrets were taken in prairie-dog towns, and one of Mrs. Maxwell's specimens had been drowned out of a prairie-dog hole and captured alive. This individual was kept in confinement for some time. "It became quite tame, readily submitting to be handled, though it was furious when first caught. It was kept in a wire cage and fed on beef. When irritated it hissed and spat like an angry cat. It used to hide by covering itself over with the material of which its nest was composed, but at times, especially at night, it was very active and restless." [4]

Putorius longicauda (Bonaparte). Long-tailed Weasel.

The large long-tailed weasel of the plains should be present over practically all of the State east of the mountains, but until thorough collecting is done there, its abundance and distribution can not be indicated. It is not known from the mountains of Colorado. Weasels from the lower edge of the foothills are referable to the slightly smaller *P. arizonensis*, so it is quite probable that *P. longicauda* is restricted to the plains well out from the mountains. It probably occurs over a considerable area in western Routt County, since a male in the Warren collection from the sage plains at Lay, examined by the Biological Survey, is referable to this species. Another Colorado specimen of *P. longicauda* examined by the Biological Survey was taken at Wray, Yuma County, and is in the collection of the Colorado Historical and Natural History Society in Denver. Weasels reported present in Baca County are undoubtedly of the long-tailed species. Warren, on the authority of A. E. Beardsley,[1] records *P. longicauda* from Platte River and Greeley.

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[1] The Mammals of Colorado, p. 194, 1910.

[2] Ibid., p. 264, 1906.

[3] Fur-bearing Animals, pp. 150-151, 1877.

[4] Dartt, On the Plains and Among the Peaks, p. 220, 1879.

Putorius arizonensis Mearns. Mountain Weasel.

This weasel is tolerably common in the mountainous parts of the State, and replaces *P. longicauda* of the plains from the eastern base of the foothills westward. It has a wide vertical range and occurs on both slopes of the Continental Divide from 5,000 feet to timberline. The only other weasel found in the Colorado mountains is the much smaller *P. s. leptus*.

In 1905 and 1906 four specimens were collected at Steamboat Springs; Meeker; Higho, North Park; and Tunnel, Mesa County. Another weasel, which was not secured, ran across the trail in front of us at Boulder Falls, on Middle Boulder Creek, and took refuge in a pile of rocks. Mr. Frank Hayes, a taxidermist of Glenwood Springs, showed me several skins from the head of Noname Creek, Garfield County. Large weasels which can without much question be referred to this species were reported in Middle and North Parks; Escalante Hills; valleys of the Green, White, and Grand Rivers; Medano Springs ranch; Westcliffe; Bradford; Gardner; La Veta; Pagosa Springs; Rogers Mesa, near Hotchkiss; Placerville; and Lone Cone, San Miguel Mountains. The lumbermen at Fraser, in eastern Middle Park, report that a great many weasels live among the log piles, where they prey upon chipmunks. Mr. T. J. McKenna, of the Stevens Mill, at timberline on Mount McClellan, states that large weasels are common and tame about the mill and often come into the cabins during the heavy snows of winter. Mr. Edward A. Preble saw one at timberline on Longs Peak in 1895. There are two white winter specimens from Coventry. Warren has taken *P. arizonensis* at Colorado Springs, and states that one was killed at Crested Butte,[2] while another specimen which he sent to the Biological Survey for identification came from Sapinero. A winter specimen from Semper, Jefferson County, has been identified for Mr. W. D. Hollister, of Denver, and another from the San Luis Valley (between Monte Vista and Del Norte, November 24, 1903) for the Colorado Historical and Natural History Society. The last specimen is a male in nearly full winter pelage, and measures: Total length, 425; tail vertebræ, 155; hind foot, 46.5.

This weasel frequents the piles of large bowlders and débris in canyon bottoms and along mountain streams, where it preys chiefly upon mice, chipmunks, and Say spermophiles. When surprised in the open, it immediately seeks refuge among the nearest rocks, but once in this safe retreat its curiosity overcomes its fear, and it is seldom out of sight for more than a moment. It frisks in and out among the rocks, stopping now and then to crane its long neck at the observer, and even stands erect on its hind legs to get a better view of the object of its curiosity. Occasionally it is found at a distance from rocks. At Steamboat Springs I shot one as it ran past my camp among the alders on the bank of Bear River, and one of two specimens from near Cochetopa Pass was shot by Loring on a fence rail in a cultivated field. One seen by Prof. Lantz near Edlowe, Teller County, took refuge in a prairie-dog burrow. A weasel shot among the White River bluffs east of Meeker was carrying a large *Callospermophilus* in its mouth.

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[1] Mammals of Colorado, p. 264, 1906.

[2] Ibid., p. 265, 1906.

This is doubtless the weasel noted by Allen in Park County in 1871 and recorded as *P. ermineus,*[1] and also the species recorded by Coues as *P. longicauda* from the "mountains of Colorado."[2] A summer skin from Fort Garland, recorded by Coues and Yarrow as *P. longicauda,*[3] is not available for examination, but may be referred to *arizonensis* on geographic grounds.

Putorius streatori leptus Merriam. Dwarf Weasel.

Putorius streatori leptus Merriam, Proc. Biol. Soc. Wash., XVI, p. 76, 1903. Type from Silverton, San Juan County, Colorado.

The meager data bearing on this beautiful little weasel indicate a general distribution in the higher mountains over the State. (See fig. 27.) Very little seems to be known of its habits. Judging from verbal descriptions this is the small weasel which occasionally proves such a nuisance to trappers in the heavy forests on the higher mountain ranges by getting into marten traps in winter.

I saw a mounted specimen in winter pelage at Steamboat Springs in 1905, but beyond the fact that it was killed in the neighboring mountains the proprietor could tell nothing of its history. At Glenwood Springs, in August, 1907, Mr. William Cross, a taxidermist, told me that he had recently seen one of these diminutive weasels in brown summer pelage peering from beneath the sidewalk, but failed to secure it. Mr. Cross showed me a winter skin which he had obtained from a trapper in the Glenwood region. Mr. Anton Stark, agent of the Colorado & Southern Railroad at St. Elmo, in the Saguache Mountains, reports the dwarf weasel as not uncommon thereabouts. One which he captured in winter and kept in confinement became so tame that it was finally allowed its freedom, but remained about the house for some time and proved an expert mouser.

Mr. D. Costello, of Gardner, Huerfano County, relates an incident which occurred many years ago while he was prospecting in the mountains of northern Gunnison County, back of Crested Butte. Soon after locating in a cabin adjacent to a large rock slide just below timberline he discovered that a cony was occupying a large grass nest beneath the cabin floor. It often appeared in the cabin, coming up through a broken board in the floor, and in time became very friendly. Finally a day came when the cony did not make its usual appearance, but a tiny weasel was seen at the hole in the broken board, peering in all directions and craning its long slim little neck with the bold curiosity so characteristic of the larger weasels. Fearing for the welfare of the cony, Mr. Costello killed the tiny cutthroat, but apparently too late, as he saw no more of his interesting companion. It seems probable that the cony is often preyed upon by this weasel, as the same rock slide often harbors both animals. *P. leptus* is only about 6 inches in length, exclusive of the short black-tipped tail of 1 or 2 inches, and the body is little larger around than that of a small mouse.

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[1] Bull. Essex Inst., VI, p. 54, 1874.

[2] Fur-bearing Animals, p. 141, 1877.

[3] Explorations W. of 100th Meridian, V, p. 59, 1875.

Mr. Walter Blanchard has presented the Biological Survey with a brown summer specimen of *P. leptus*, which was killed on his ranch 5 miles west of Boulder in June, 1902. The type specimen from Silverton, in beautiful white winter pelage, was shot by Loring October 20, 1893, as it was peering from under a log. Another immature specimen from the same locality was caught in a trap set in the underground tunnel of a pocket gopher (*Thomomys fossor*), which suggests that this gopher may form part of the weasel's bill of fare. Another specimen in the Biological Survey collection was obtained at Crested Butte February 17, 1902, by Warren, who gives the following observations on this species: "About Crested Butte, judging from the tracks one sees after a fresh fall of snow, it is quite common. It often burrows under the surface of the light snow, and runs beneath for quite a distance, then reappears on top, having been hunting down a mouse."[1] Recently *P. leptus* has been recorded from Coventry, Montrose County.[2] A male winter specimen from Larimer County is in the collection of the State Agricultural College at Fort Collins. One from Boulder County, in the Field Museum of Natural History, is recorded by Elliot.[3] A specimen from near Boulder in the mounted collection of Colorado mammals, exhibited by Mrs. M. A. Maxwell in Washington in 1876–77, has been recorded by Coues as "the least weasel, *Putorius vulgaris*,"[4] and was very likely the present form.

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[1] Mammals of Colorado, p. 264, 1906.

[2] Warren, The Mammals of Colorado, p. 198, 1910.

[3] Field Col. Mus. Pub., 115, VIII, p. 449, 1907.

[4] Dartt, On the Plains and Among the Peaks, p. 220, 1879.

Mustela caurina origenes Rhoads. Rocky Mountain Marten.

Mustela caurina origenes Rhoads, Proc. Acad. Nat. Sci. Phila., p. 458, 1902. Type from Marvine Mountain, Garfield County, Colorado.

In the dense forests of lodgepole pine and spruce which clothe the upper slopes of the higher mountain ranges of northern Colorado the marten is still present in considerable numbers. It appears to be uncommon on all the southern ranges except the San Juan Mountains, where from a point northeast of Pagosa Springs west to Silverton and Telluride it is reported in good numbers. Martens are rarely observed below 8,000 or 8,500 feet, or the lower edge of the Canadian zone forest belt. They range regularly to timberline, however, and have been seen 1,500 feet above timberline near Silverton.

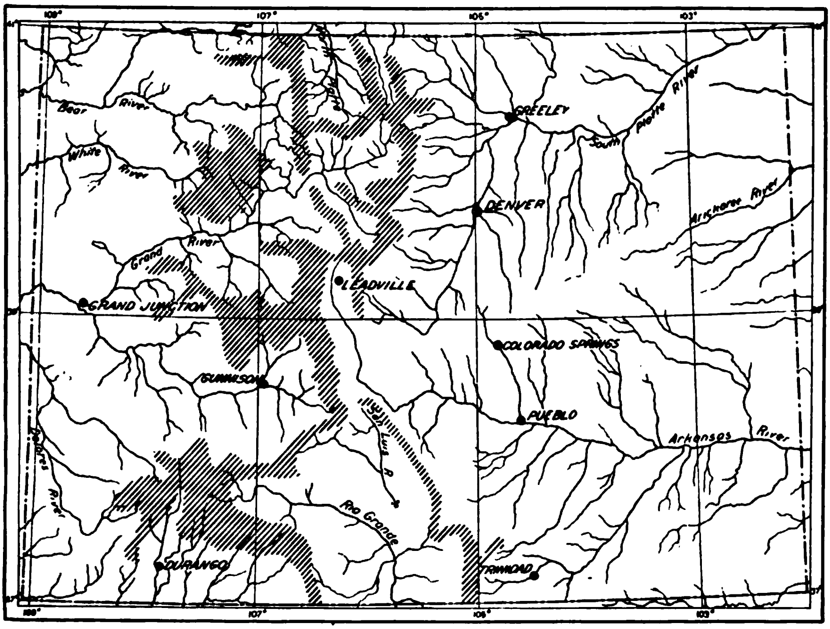

FIG. 28.—Distribution in Colorado of marten (*Mustela caurina origenes*).

Throughout their range (see fig. 28) martens are hunted and trapped extensively, and consequently are not nearly so abundant as formerly. Ski are often used in hunting them in winter, when snow covers the mountains to a depth of several feet, and when pursued in this manner the animals quickly take refuge in trees, where they are easily shot. Hunting martens on ski is said to be very exciting sport, and at times hazardous, owing to the roughness of the country. This is a favorite method of hunting in Middle Park and in the San Juan Mountains. Most of the martens secured, however, are taken in either steel traps or deadfalls. Although Colorado martens are somewhat paler than those farther north, they nevertheless yield a valuable fur.

Most of my information on the present distribution and abundance of martens relates to the northern half of the State. During the period from 1900 to 1905 the following were considered the best regions for martens: The mountain ranges surrounding Middle and North Parks; the Williams River Mountains and the eastern part of the White River Plateau, west of Egeria Park; and the mountains south of Aspen, Pitkin County. Mr. Fred N. Selak, of Coulter, Middle Park, informed me in 1905 that he handled from 25 to 30 marten skins each year, taken chiefly in the Rabbit Ear and Williams Mountains and along the western slope of the Front Range near Arapahoe Peak. Alpert & Co., of Kremmling, receive a few skins each year from the Gore Mountains. Mr. W. H. Graham, of Spicer, North Park, states that he usually traps between 10 and 20 martens each winter in the Rabbit Ear Mountains, near the head of Arapahoe Creek. The animals are reported common on the Park Range but very rare on the Medicine Bow Range. Many trappers market the fur in Denver. A conservative estimate of the annual catch in the Middle and North Park region would be 100 skins.

In August, 1905, Mr. Frank Hayes, a taxidermist of Glenwood Springs, showed me skins of four martens trapped the previous winter at Bennett's Well, on the head of Noname Creek, 8 miles northeast of that point. He had also purchased a number of skins taken on Divide Creek, south of Newcastle, and at Mud Springs, on the White River Plateau. Mr. Hayes was located at Aspen about 1900, and handled between 40 and 50 marten skins each year, nearly all of which came from near the Montezuma mine, on the east slope of Hayden Peak. Two other fur buyers were located in Aspen at the same time, and Mr. Hayes estimates that fully 100 skins were marketed there annually. This region is probably at present the best marten country in Colorado. Mr. Robert McIntosh, of Slater, received 10 marten skins from the Elk Head Mountains during the winter of 1905–6. Martens are reported rare on the high timbered divide east of Laramie River and on the headwaters of Grand Encampment River.

Mr. Steve Elkins, of Mancos, reports a few in the spruce belt of the La Plata Mountains, and I am informed they are tolerably common in the extensive forests of Engelmann spruce on the mountains west of Rico. They seem to have been always rare on the Sangre de Cristo Range. Mr. E. W. Scott, of La Veta, has the skin of a marten killed in the spruce belt on East Spanish Peak in the winter of 1904–5, and states that he has seen three other marten skins from the same mountain. Mr. T. J. McKenna, of Denver, states that 30 years ago he trapped a great many martens near the Tin Cup mine, and on the headwaters of the Cimarron River, in Gunnison County. Skins which Loring saw at Grand Junction in 1893 probably came from the Grand Mesa country.

The type and one topotype of *M. origenes* in the National Museum were collected in Garfield County, near Mount Marvine, in September, 1901, by Mr. E. Thompson Seton. The skulls may be readily distinguished from those of *M. americana* by the small, flattened, rectangular bullæ and the peculiar saddle-shaped upper posterior molar.

(?) **Mustela pennanti** Erxleben. Fisher.

In his list of the mammals of Park County, Allen records the fisher as "more or less common."[1] I have made careful inquiry of old hunters and trappers throughout the heavily forested region of the northern Colorado mountains and have yet to meet one who is familiar with the fisher or who has even heard of the animal within the State. Warren does not record it and it seems probable that Allen's record was based on erroneous information.

Gulo luscus (Linnæus). Wolverene.

In the high Canadian zone forests of the wilder parts of the mountains the wolverene is still occasionally seen. While never common in the State, it was formerly of general occurrence. At present it appears to be restricted largely to the San Juan and La Plata Mountains, the mountains of northern Gunnison County, and the ranges surrounding North and Middle Parks.

Mr. W. H. Graham, of Spicer, North Park, states that wolverenes are occasionally reported from the Rabbit Ear Mountains, but that very few have been killed during recent years. He saw a track on the head of Arapahoe Creek during the winter of 1904–5, and in the fall of 1903 saw a wolverene which a trapper caught on Owl Mountain, in southeastern North Park. The wolverene was considered very rare in Middle Park in 1905. Mr. Fred Selak, of Coulter, reported that one was killed in the fall of 1903 near the head of Ranch Creek, on the western slope of the Front Range. Two skins, which were purchased by Alpert & Co., of Kremmling, in 1903, were said to have been trapped the previous winter in the heavy forests on the head of the Williams Fork of Grand River. Mr. T. J. McKenna, of Denver, states that while at the Tin Cup mine, in Union Park, Gunnison County, in the summer of 1883, he saw a wolverene which had been killed in that vicinity. He says it was not at all rare in the mountains of Gunnison County 25 or 30 years ago.

Mr. Wood Galloway, of Norwood, states that for many years his father had a wolverene skin, taken in Antelope Park, Mineral County, and says the animals were not at all uncommon in that section 30 years ago. A wolverene shot at the east base of Pagosa Peak in the winter of 1905 was mounted and on exhibition in Pagosa Springs until 1907, when it was sent to Denver with a miscellaneous mounted collection. Mr. H. N. Wheeler, formerly supervisor of the Montezuma National Forest, has a wolverene skin said to have been taken in the spruce belt near Calico Mountain, west of Rico, in 1905, and through other sources I learn that these animals are of occasional occurrence in the La Plata Mountains. One is said to have been killed near the Silver Picket mine, on Mount Wilson, in the San Miguel Mountains, about 1895, and according to Mr. D. Costello, of Gardner, one was killed on the head of Huerfano River many years ago.

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[1] Bull. Essex Inst., VI, p. 54, 1874.

Allen says the wolverene was not uncommon in Park County in 1871, and he saw the skin of one taken near Montgomery;[1] while it formerly occurred in Clear Creek County, according to Trippe.[2] Coues mentions a specimen in the collection of Colorado mammals exhibited by Mrs. M. A. Maxwell at the Philadelphia Exposition. It was caught in a steel trap in the mountains near Boulder.[3] In an interesting general account of the wolverene Mr. C. A. Cooper describes his capture of an old male in the heavy forest on the summit of Gore Pass, between Middle and Egeria Parks, during the winter of 1883, and also mentions four beautifully marked wolverene skins which he examined at Trappers Lake, Garfield County, in the winter of 1889,[4] while a companion of Cooper's reported seeing a wolverene in Rock Creek Canyon, Egeria Park, in 1888.[5] Warren records a wolverene taken near Irwin, Gunnison County, about 1890, and states that he saw fresh tracks in the snow near Irwin in October, 1905, at an elevation of 11,000 feet.[6] A specimen in the Carter collection in the Colorado Museum of Natural History was taken near Breckenridge, Summit County.

Bassariscus astutus flavus Rhoads. Civet Cat; Cacomistle.

The data at hand bearing on this handsome and interesting animal are rather meager and unsatisfactory, and probably do not well indicate its distribution and abundance in Colorado. The species appears to be restricted to the Upper Sonoran zone, and with a single exception all the records are from the rough canyon country in the lower southwestern part of the State from the Grand River Valley southward.

The civet cat is tolerably common on Mesa Verde and thence north to the southern base of the Uncompahgre Plateau. In June, 1907, I saw its small, round, cat-like tracks in the dust beneath many of the overhanging rock ledges along Navajo Canyon, 25 miles southwest of Mancos; while among the Spruce Tree Cliff Ruins at the head of this canyon, and particularly in the darkest recesses of the cavern behind the ruins, the footprints of civet cats, leading here and there among the numerous smaller tracks of cliff mice and wood rats, were plainly discerned in the thick layer of fine rock dust. However, none came to meat-baited traps which I scattered along the ledges. Mr. Steve Elkins, of Mancos, states that he has seen a civet cat which was killed in Mancos Canyon. This species is not reported in McElmo Canyon, and seems to be little known to the hunters of Montezuma County, but this is not strange, since it is nocturnal, and in hunting for cliff mice and wood rats rarely leaves the caves and deeper recesses in the rocky walls of canyons. A mounted specimen which I saw in Durango probably came from either Montezuma County or southern La Plata County.

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[1] Bull. Essex Inst., VI, p. 54, 1874.

[2] See Coues, Birds of the Northwest, p. 224, 1874.

[3] Dartt, On the Plains and Among the Peaks, p. 219, 1879.

[4] Big Game of North America, pp. 479-501, 1890.

[5] Ibid., p. 492, 1890.

[6] Mammals of Colorado, p. 262, 1906.

The civet cat is more generally known in the region bordering the lower San Miguel and Dolores Rivers. Mr. Henry Huff, an Indian living at Norwood, who trapped in the Dry Creek Basin, in western San Miguel County, during the winter of 1906–7, states that the "ring-tails" are not at all uncommon among the ledges of that region. A fine adult civet cat caught by him and an immature individual taken the same winter in the canyon of San Miguel River, a few miles north of Coventry, are in the Warren collection. Civet cats are reported from the Tabeguache Canyon, north of the San Miguel, and Mr. J. P. Galloway, of Norwood, informed me of five which were killed some years ago at the Sunrise copper mine in West Paradox Valley.

There are three Mesa County records of civet cats. In June, 1893, Loring saw a skin in a fur buyer's store at Grand Junction which was said to have been taken the previous fall about 4 miles from that place. A specimen which the National Museum obtained from Conductor Tuttle of the Colorado Midland Railway, was caught by a trapper in Mesa County a few years ago, and was mounted by Mr. C. E. Aiken, of Colorado Springs. The history of this specimen is given by Dr. W. W. Arnold in Outdoor Life.[1] Warren records *Bassariscus* from Delta on the authority of A. E. Beardsley.[2] An animal answering its description was reported to Mr. C. E. Aiken from Beaver Creek, Fremont County, some 25 miles south of Colorado Springs, in 1904.

Procyon lotor (Linnæus). Raccoon.

The data on the distribution and abundance of the raccoon within the State are somewhat limited and probably do not indicate the extent of its range. It is tolerably common on the eastern plains, along some of the larger foothill streams, and in the extreme south from the San Luis Valley west to La Plata County. According to Warren, the animal has been taken in Grand County, west of the Front Range.[3] It has not been found in the lower northwestern part of the State. Whether the raccoons which reach the southern counties from the south and southwest, along the Rio Grande and the San Juan River and tributary streams, are distinct from those east of the mountains is not certain, as no specimens are available for comparison. It seems probable, however, on geographic grounds, that the raccoons occurring west and south of the San Juan Mountains, in Archuleta and La Plata Counties, are *P. mexicanus*. The raccoons which were reported in 1907 from the San Luis Lakes and the cottonwood-fringed streams at the western base of the Sangre de Cristo Range may have reached the San Luis Valley from the east by crossing over the low Mosca Pass from the head of the Huerfano River.

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[1] Outdoor Life, p. 933, Nov., 1905.

[2] Mammals of Colorado, p. 260, 1906.

[3] Further Notes on Mammals of Colorado, p. 83, 1908.

Raccoons are stated to be common at a number of points on the plains east of the mountains, and probably occur along all the larger streams, which are well fringed with cottonwoods, and follow them some distance into the foothills. There is a skull from the foothills near Arkins, Larimer County, and the distribution in the foothills is further indicated by reports from Gardner and La Veta, Huerfano County. A specimen in the Warren collection from the mouth of the Platte Canyon, Douglas County, has been examined by the Biological Survey. Raccoons are said to be tolerably common in the marshes and along streams in the Loveland region. Loring, who secured a specimen at Loveland in 1897, states that he captured it in a cat-tail marsh which was bordered by a fringe of cottonwoods, and he thinks the animals were living in holes in the banks at that point, rather than in hollow trees. At Las Animas in July, 1892, Dr. A. K. Fisher noted along the Arkansas River and on the banks of irrigation ditches a great many tracks made by raccoons searching for frogs. Prof. D. E. Lantz reported a few raccoons on Big Sandy Creek, near Hugo, in 1905. Warren says they are found at Watervale, in south central Las Animas County.[1]

In May, 1909, raccoons were abundant among the sandstone ledges along the South Fork of the Republican River at Tuttle and in similar situations at Wray, while many tracks were seen on sandbars in the South Platte River 2 miles northeast of Sterling. Several dens were located among the rocks near Tuttle, at one of which, within 50 yards of our camp, a large, dark-colored female raccoon was trapped. Dismal howls and barks, not unlike those of a dog, advised us of her capture one night about 10 o'clock. The raccoons at Tuttle were feeding extensively upon grasshoppers, and the excrement found near the dens consisted very largely of the remains of those insects.

Raccoons are said to follow up the Los Piños as far as Bayfield, La Plata County, and are found in small numbers along the San Juan River to Pagosa Springs, but I was informed at both localities that prior to 10 or 15 years ago none were present. At Arboles I saw tracks in a dry arroyo extending north from the San Juan River.

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[1] The Mammals of Colorado, p. 219, 1910.

Ursus americanus Pallas. Black Bear.

The black bear is still tolerably common in the wilder parts of the mountains, especially in the ranges surrounding North, Middle, and Egeria Parks, and in the Elk, Saguache, San Juan, and La Plata Mountains, where the forests are most extensive. It is dichromatic, as in other parts of the Rocky Mountains, and the numerous skins examined and the statements of hunters and trappers indicate that black, brown, and cinnamon animals frequently occur in the same localities. The typical black phase is least common in the southern mountains and at the lower elevations, but is more frequent in the northern part of the State.

In a series of nine very large skins which I examined in the store of Fred Selak, near Coulter, Middle Park, five were brown and four black. They had been purchased from a trapper living in the Vasquez Mountains, near the headwaters of the Williams Fork of Grand River. Most of them had been taken in large log traps, and as a consequence had mutilated their claws by their efforts to escape. A number of bears are killed each spring in the lodgepole pine and spruce forests on the mountain ranges bordering Middle Park, and skins from this section brought about $25 each in 1905–6. In the aspen forests on the White River Plateau, and near Arapahoe Pass, in the Rabbit Ear Mountains, many of the larger trees were badly scarred to a height of 8 feet or more by the claw marks of bears. In October, 1906, I saw the tracks of a medium-sized bear in the snow above timberline near Berthoud Pass. Bears were reported in varying numbers in 1905–6 on the Medicine Bow, Park, and Gore Ranges, Elk Head and Williams River Mountains, Danforth Hills, and Mount Cullom, west of Green River. Tracks are said to have been seen among the pinyons near Douglas Spring, in the Escalante Hills, in the winter of 1905–6. At Glenwood Springs I saw many skins from the high country south of Grand River and others from the White River Plateau.

Bears are now becoming scarce on the eastern slopes of the Front Range. In 1893 Loring reported them common in the Estes Park region, one trapper having killed 14 in three years; but the animals are stated to be rare at present in the higher parts of Clear Creek County (Floyd Hill and Grays Peak).

Bears were not considered uncommon in the mountains of southern Colorado in 1907, being reported in greatest numbers in the Cochetopa Hills, in the San Juan Mountains north of Pagosa Springs and Vallecito, in the La Plata Mountains northeast of Mancos, and in the San Miguel Mountains from Mount Wilson west to Lone Cone. They occur more or less commonly the entire length of the Sangre de Cristo and Culebra Ranges, particularly on the more heavily forested eastern slopes, and also in the West Elk Mountains and on the

Uncompahgre Plateau. They are rare in the rough parts of Las Animas County. Prof. Lantz heard of one which was killed 20 miles south of Higbee about 1908.

In the Pagosa Springs region, as elsewhere, bears are usually found in the aspen and spruce belt, but they occasionally come down from these elevations into the yellow pine forests and kill many sheep. The winter dens are left about May 1, or sometimes earlier, and, as sufficient snow for tracking remains in the higher country for another month, May is considered an excellent time for bear hunting. Most of the hunting is done with hounds, and large packs of bear dogs are owned at both Pagosa Springs and Mancos, which are probably the best two outfitting points for bear hunts in the southern mountains. A number of hunting parties were located in the mountains north of Pagosa Springs at the time of my visit, late in May, 1907. A large black bear was killed on Pagosa Peak May 30, and a little earlier in the same month an old female and cub were killed on Middle Mancos River, 10 miles east of Mancos. A brown cub was roped at the Evans sawmill, near Vallecito, a few days before I reached there, June 5. Mr. Steve Elkins, of Mancos, one of the most successful bear hunters in southwestern Colorado, states that the largest black bear which he has killed in the La Plata Mountains weighed very nearly 500 pounds.

In the San Miguel region bears appear to occur regularly at a lower altitude than elsewhere in Colorado, and are not uncommon down into the pinyon country. One is said to have been killed within a mile of Placerville in the spring of 1907, while in the well-settled country between Coventry and Norwood a large brown bear was seen at the carcass of a cow in an open field a few days before my arrival, July 1. The animals are occasionally seen along Naturita Creek near Coventry. In the pinyon country of western San Miguel and Montrose Counties the cinnamon phase prevails, and very light colored individuals are not uncommon. Mr. Henry Huff, an Indian living at Norwood, showed me the skin of a remarkably light colored yearling cub which he had captured in the Dry Creek Basin by crawling into the den after killing the mother, an old cinnamon, and the other cub. This skin was a pale creamy yellowish white throughout, with the exception of the face and nose, which were very light brown.

Bear signs were abundant in the aspen belt on Lone Cone late in July. A great many of the aspens were scratched and clawed, many of the marks being recent. Two trees showed plainly where the animals had climbed to the upper branches—sure evidence that they were not grizzlies. The claw marks on these trees were very distinct to a height of 30 feet or more. (See fig. 29.) Other bear signs—chiefly overturned logs and rocks where the animals had been searching for ants and beetles—were abundant on Lone Cone, and indicated that the region was one of bruin's favorite ranges.

The Biological Survey has a series of 10 bear skulls which Mr. Theodore Roosevelt secured on Divide Creek, Garfield County, in April, 1905; also three from Pagosa Springs, taken in the summer of 1907. Skulls in the National Museum were collected by Mr. E. Thompson Seton in the Rifle region and near Mount Marvine. Allen found black and cinnamon bears in about equal numbers in Park County in 1871.[1] Coues and Yarrow mention a specimen obtained by Lieut. Marshall at Pagosa Springs in 1874.[2]

Ursus horribilis Ord. Grizzly Bear; Silver-tip.

At present grizzly bears are uncommon, if not rare, in the northern mountains, but are occasionally seen in the wilder mountains of southern Colorado, particularly in the San Juan, La Plata, and San Miguel Ranges. Many of the data respecting the grizzly (or silver-tip, as it is generally known to hunters) within the State, past and present, are unsatisfactory and somewhat conflicting, many of the reports undoubtedly referring to black bears, or more often to large cinnamon bears.

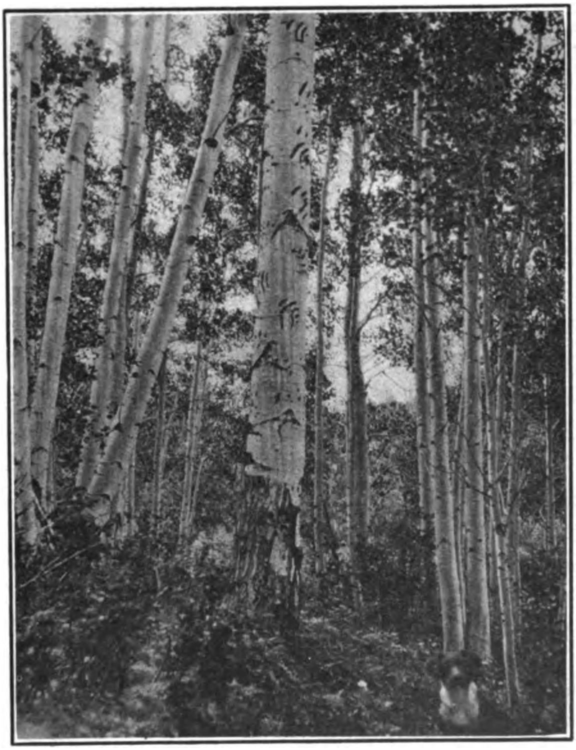

FIG. 29.—Claw marks of black bear on aspen (*Populus tremuloides*), Lone Cone, San Miguel Mountains, at 10,000 feet.

In 1905–6 the best informed hunters and trappers in the northern mountains considered the grizzly rare. The reports which follow seem to refer beyond question to this species. A very large old silver-tip was reported in the region about Strawberry and Grand Lakes, in northeastern Middle Park, in 1905. This old fellow is said to have ranged that part of the western slope of the Front Range for a number of years, and is well known to the hunters of the region as Old Saddleback—so called because of an area of light-colored fur near the middle of the back.[1] Another very large bear was reported the same year from Mount Baker, at the eastern end of the Rabbit Ear Mountains, and according to well-informed hunters a few silver-tips were yet to be found in the vicinity of Pyramid Peak, in the mountains west of Egeria Park. The skin of a two-thirds-grown silver-tip killed near Sleepy Cap, Williams River Mountains, in October, 1890, by Mr. Oscar Lampton, of Montrose, has front claws 3 inches in length, following the curve. Lumbermen at the tie camps on the headwaters of Grand Encampment River, at the northern end of the Park Range, stated that a large silver-tip often came about the camps during the spring of 1906. Mr. William Cross, the Glenwood Springs taxidermist, showed me a photograph of the skin of a very large silver-tip killed in October, 1906, on the northern side of the Book Plateau, in extreme western Garfield County, by Mr. Harry Payne Whitney, of New Haven, Connecticut. This bear, judging from the photograph, was a remarkably large one, and the claws on the forefeet were very long and regular. The longest fore claw (measured by Mr. Cross) was exactly 4½ inches along the curve. The skull in Mr. Cross's shop was very large and massive and indicated an old animal. Mr. Cross stated that at least two silver-tips have been killed in the mountains near Gypsum during recent years—a large individual in the spring of 1903 on the head of Gypsum Creek by Mr. Muckey; and another bear, nearly grown, in the same region in the spring of 1907 by Mr. Jake Borah, the veteran Meeker hunter.

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[1] Bull. Essex Inst., VI, p. 54, 1874.

[2] Explorations W. of 100th Meridian, p. 67, 1875.

I have no data respecting the recent occurrence of this bear along the eastern slopes of the Front Range, and it appears to be now extremely rare or entirely absent. In the early seventies of last century grizzlies were not uncommon along the higher crests of the Front and Saguache Ranges. Brewer mentions six which he saw above 13,000 feet in the mountains in close proximity to Grays Peak and near Mount Yale, and says: "Judging from the few seen and from skins examined in Denver, they are smaller than those of California, the hair not so long and shaggy, the color more silvery, or truly grizzled."[2]

In the summer of 1907 considerable information was secured on the present range and abundance of the silver-tip in the southern mountains. Small numbers are found in the San Juan Mountains north of Pagosa Springs and Vallecito, and according to Forest Ranger E. E. Chapson, an average of one or two had been killed north of Pagosa Springs each spring until 1907, when none were killed. Silver-tips kill a number of cattle in the southern foothills of the San Juan some years, one having killed four head in the country to the west of Pagosa Peak in May, 1907. This is doubtless the same individual which was reported as killing cattle on the middle fork of Piedra River a few weeks later. Henshaw states that grizzlies were quite common in the higher San Juan Mountains as late as 1873. As far as could be learned, the silver-tip has a higher range than the black bear, and is rarely met with as low as the yellow pine belt.

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[1] Doubtless an extreme of the ordinary grizzling or silver tipping of the hairs, which is normally heaviest on the saddle and between the shoulders.

[2] Am. Nat., V, p. 221, 1871.

Mr. Steve Elkins, of Mancos, states that the silver-tip is encountered rather often in the La Plata Mountains and that he has killed several during the past 10 years. Among these and other skins from the La Plata region examined by Mr. Elkins, much individual color variation was exhibited, some being a faded dirty yellowish, with the hair long and shaggy, while others were dark clove brown or blackish, with hair well silvered at the tip—sleek, short-haired, and beautiful animals. The skin of a large silver-tip which was trapped on West Dolores River in the spring of 1906 is owned by Mr. Harry Pyle, of Dolores.

A silver-tip was shot on North Mesa, just west across the Naturita Valley from Lone Cone, San Miguel Mountains, October 2, 1905, by Mr. Oscar Lampton, of Montrose. In Montrose Mr. Lampton showed me the skin of this bear in the form of a beautiful full-head rug with the skull inside. It was a good-sized animal with the longest fore claws measuring 4 inches, but the unworn teeth indicated that it was young. The foreclaws on the skin of a large old cinnamon bear from the Uncompahgre Plateau, 15 miles west of Montrose, are markedly smaller and shorter than those of the smaller of Mr. Lampton's two silver-tips (from the Williams River Mountains). The silver-tips are both in good fur and agree precisely in color, being a uniform grizzled black-brown on the back; the legs, a rich dark shade of the same color without the grizzling; face, plain brown; nose, clay brown; claws, black.

Mr. Henry Huff, an Indian, and Mr. J. P. Galloway, both of Norwood, killed a very large old male silver-tip among the Engelmann spruces just below timberline on the west slope of Lone Cone, San Miguel Mountains, May 26, 1907, after a long chase from the lower north slope of the mountain. A female bear seen at the same time escaped, and is said still to range the Lone Cone country. The snow was reported to have been 8 feet deep where the old male was dispatched, and hence it was with some misgivings that we set out on July 27 to secure the skull. The Indian led us straight to the spot, however, in a dense spruce thicket where the down timber was heaviest. The snow had but recently melted, and the immense carcass had settled across a large log. Mr. Galloway estimated the weight of the bear when killed at between 800 and 1,000 pounds, and states that the skin at the time of its removal from the body was so heavy that he and his companion had great difficulty in packing it upon a horse. The stomach of this bear, examined on the day it was killed, contained nothing but a double handful of ants and the larvæ of wood-boring beetles. Fortunately, the skin was at a near-by ranch at the time of my visit to Lone Cone, and I measured and photographed it. The pelt was in prime condition, with a uniformly short, dense pelage, shortest on the back between the shoulders, where the hair averaged about 3⅛ inches in length, and longest on the sides of the upper forelegs, where it averaged 6¼ inches. The Indian aptly likened the flaps of long shaggy hair on the upper forelegs to a cowboy's chaps, and said the resemblance in life was most striking. The fur was a dark, rich clove brown at base throughout, shading into plain brownish black on sides and on fore and hind legs; ears and face, dark brown; nose, clay brown; dorsal area, from rump to between ears, a beautiful silvery clove brown, brightest between shoulders, owing to greater length of silvered area at tips of hairs. The ears were comparatively short, but could not be accurately measured on the dried skin. The following skin measurements indicate the large size of this bear, although they are probably somewhat exaggerated on account of stretching: Distance between tips of fore claws, outstretched skin, 96½ inches; length from tip of tail to end of nose, outstretched skin, 87 inches; longest fore claw, along curve, 4¼ inches; across angle (straight), 3⅛ inches; hind claws (badly worn), under 1 inch. Mr. Galloway's flesh measurements of hind foot were: Heel to tip of claws, 12½ inches; across base of toes to edge of hair on side, 7½ inches. The old age of this bear was indicated by the much-worn teeth and hind claws. One of the massive upper incisors was a mere stub, having been broken off for some time. Several rifle balls had penetrated the posterior part of the skull and badly shattered it, but the anterior part was in good condition.

Mr. E. R. Warren, of Colorado Springs, has in his collection the skull of a medium-sized silver-tip which was killed some years ago in the Dry Creek Basin, west of the San Miguel Mountains, by Mr. Jack Watson, of Norwood. The Dry Creek Basin is Upper Sonoran country, the altitude being not over 6,000 feet—an unusually low elevation for the silver-tip.

While on Lone Cone, July 27, I photographed a large aspen which plainly showed fairly fresh claw marks of a large bear, apparently a silver-tip, to a height of 13 feet. Several other aspens on the upper slopes of Lone Cone were claw-marked by silver-tips, but most of the scratching was old.

Grizzlies are becoming very scarce on the Sangre de Cristo and Culebra Ranges, but are still occasionally encountered among the Cochetopa Hills west of Saguache. A large individual is said to have been taken in a trap on the head of Trinchera Creek in the spring of 1907 by Mr. George Wheeler, of Fort Garland. That the grizzly was occasionally met with east of the mountains in early times is shown by an account of a bear which killed Lewis Dawson, a member of Jacob Fowler's party, at the mouth of Purgatory River in 1821.[1]

The National Museum has the skin and skull of a grizzly killed near Twin Lakes July 28, 1876; a skull from Burro Mountain, near Elwood, in the San Juan Mountains; and two skulls of bears killed on Miller Creek, in the Glenwood Springs region, in either 1896 or 1897. The Biological Survey has skulls from Pagosa Springs and Lone Cone, and Coues and Yarrow mention a skin secured near Pagosa Springs in 1874 by Lieut. Marshall.[2]

Scalopus aquaticus intermedius (Elliot). Plains Mole.

Moles enter the northeastern part of the State from the plains. Thus far they are known only from Yuma County, but very likely occur throughout the sand hill region from the Arickaree Valley north at least to Holyoke. I found them abundant at Wray in December, 1907, in the valley along Chief Creek, and especially numerous in the young apple orchard of Mr. W. E. Wolfe, a mile east of the town. The loose sandy loam soil of this orchard of several acres was furrowed with a network of mole runways. Notwithstanding the great abundance of moles on his ranch, Mr. Wolfe has detected no injurious effects from their presence, and considers that they confer a benefit by thoroughly working over the surface soil in search of worms. A male was trapped in Mr. Wolfe's orchard December 13, when the ground was partially frozen and covered with a 3-inch fall of snow, which is good evidence that moles are active in loose soil during winter weather. I again visited Mr. Wolfe's orchard in May, 1909, but found only one fresh mole runway. Several older runways seen, however, indicated that the animals either were inactive or were working at a considerable depth. In driving from Wray to Yuma I saw mole runways in the sand at two points, 5 and 12 miles, respectively, west of Wray. At Yuma a small colony was working in soft soil on the embankment along the Burlington Railroad a mile east of town. No signs of moles were seen in driving northwest from Yuma to Sterling.

The Wray specimen agrees very closely with topotypes of *S. a. intermedius* from Alva, Oklahoma, in small size, pale coloration, and particularly in small size of skull. The skull of this specimen measures: Total length, 33.9; mastoid breadth, 17.4; palatal length, 15. Skin measurements are: Total length, 145; tail vertebræ, 28; hind foot, 23.

An alcoholic specimen from Dry Willow Creek, 12 miles southeast of Wray, in the collection of the Colorado Historical and Natural History Society, has been recorded by Warren.[3]

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[1] Journal of Jacob Fowler. New York, 1898.

[2] Explorations W. of 100th Meridian, V, p. 66, 1875.

[3] Further Notes on Mammals of Colorado, p. 84, 1908.

Sorex personatus I. Geoff. St. Hilaire. Masked Shrew.

This species is apparently far less common and widely distributed in the Colorado mountains than *S. obscurus*, although at one point—St. Elmo, at 10,000 feet in the Saguache Mountains—it was the more common of the two. I have found it at only two localities in the mountains of northern Colorado—an adult male being taken at 9,000 feet on Arapahoe Pass, Rabbit Ear Mountains, in a damp, mossy place on a cold north slope; and a female being trapped in a cold bog near Pearl, in the northern end of North Park, at 8,500 feet. At St. Elmo, in October, 1907, eight specimens of *S. personatus* were taken in three nights' trapping, chiefly beneath mossy rotten logs in the damp thickets of Engelmann spruce along Chalk Creek. The above specimens are in all respects typical *S. personatus*, but one from Loveland, at the eastern base of the foothills, shows an approach to the paler and grayer plains form *S. p. haydeni*.

Several specimens of *S. personatus* taken by Mr. R. T. Young in the vicinity of Boulder, and at Buchanan Pass, Boulder County, are in the National Museum. Others from Irwin, Gunnison County, at 10,700 feet; Lake Moraine, El Paso County, at 10,250 feet; and Mud Springs, on the White River Plateau, at 8,850 feet, are in the Warren collection. Warren states that he has recently identified specimens from the Summit House on Pikes Peak, 14,147 feet altitude.[1] A specimen from Marvine Lodge, Rio Blanco County, is recorded by Felger.[2]

Sorex obscurus Merriam. Rocky Mountain Shrew.

This is the common shrew of the high Colorado mountains in the Canadian and Hudsonian zones. Specimens from timberline on Longs Peak and Mount McClellan indicate its upper limits, while on cold slopes and along streams, where the conditions are semiboreal, I have taken it as low as 5,800 feet, and it has recently been recorded from Boulder (5,400 feet).[3] It is usually trapped in mountain bogs and beneath moss-covered rotten logs in spruce and aspen forests. In a grassy mountain park near Gore Pass, between Egeria and Middle Parks, one was secured in a runway of *Microtus nanus*, at some distance from the forest; while Loring trapped a specimen in a cabin near Silverton. Three of these shrews got into my traps set among rank vegetation in an aspen bog near Uncompahgre Butte, on the Uncompahgre Plateau, at 9,000 feet, July 17, 1907. At St. Elmo, in the Saguache Mountains, at 10,000 feet, I collected two specimens in October in the damp spruce thickets along Chalk Creek. This shrew was not so common as *S. personatus* at this point. The mountain shrew is chiefly nocturnal, but Loring caught one at Gold Hill during the daytime, and one afternoon at Baxter Pass, on the Book Plateau,

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[1] The Mammals of Colorado, p. 263, 1910.

[2] Univ. of Colo. Studies, VII, No. 2, p. 146, 1910.

[3] Young, Proc. Acad. Nat. Sci. Phila., p. 407, 1908.

I saw one running about under a spruce log. Specimens of this species from a great many Colorado localities are in the Biological Survey collection.

Sorex vagrans dobsoni Merriam. Dobson Shrew.

A specimen of the little Dobson shrew from Lake Moraine, El Paso County, which Warren sent to the Biological Survey for determination in 1905, is the only Colorado record. It was collected at an altitude of 10,250 feet.

Sorex tenellus nanus Merriam. Dwarf Shrew.

Sorex tenellus nanus Merriam, N. Am. Fauna No. 10, p. 81, 1895. Type from Estes Park, Larimer County, Colorado.

This little shrew must be very rare, as not one was captured in my three seasons' work on all the higher mountain ranges of the State.

In addition to the type, an adult female taken in Estes Park August 3, 1895, by Mr. Edward A. Preble, the Biological Survey has a skull from Westcliffe, Custer County. A third specimen from Colorado, in the Warren collection, has been identified by the Biological Survey. It was collected on Bear Creek, in the mountains near Colorado Springs.

Neosorex palustris navigator Baird. White-bellied Water Shrew.

In the Colorado mountains the large water shrew is found chiefly between 7,500 and 10,500 feet, in the Canadian zone, but I have taken it at 6,400 feet, and it has been reported once from as low as 6,000 feet. The scattered localities at which specimens have been taken indicate a general distribution over the mountainous sections. The species is always found near water, and is usually taken in traps set in the moss at the edge of mountain streamlets, or in the dense vegetation of cold bogs or mountain meadows. Little is known of its habits.

At St. Elmo, in the Saguache Mountains, I found these shrews common along some small streams tributary to Chalk Creek, in October, 1907. Three out of four specimens collected at this point were taken in traps placed on moss-covered rocks behind a small waterfall, where the vegetation was saturated by the dashing spray. Mr. J. W. Frey, of Salida, reports water shrews as common on a small stream heading on the east slope of Round Mountain, at the northern end of the Sangre de Cristo Range; and they are reported from the head of Muddy Creek, in northwestern Huerfano County. In a long line of traps set along Maverick Creek, 2 miles northeast of Coventry, the night of July 4, I secured three water shrews, all being taken in traps beneath waterfalls. The elevation is 6,400 feet, exceptionally low for this shrew, and the pinyon and juniper clad bluffs bordering the Maverick gave anything but a boreal environment to this species, which is so closely associated with cold dashing mountain streams, mossy rocks, and towering spruces. At Coventry I was informed water shrews are occasionally seen at the Stephens ranch, in the western end of West Paradox Valley, at a little under 6,000 feet. There are a number of cold springs, bordered with a dense growth of water cress at this point, which is at the eastern base of the La Sal Mountains.

Specimens in the Biological Survey collection are from Gold Hill; Elkhorn, Larimer County; Cochetopa Pass; St. Elmo; Almont; Hermit; Rico; and Coventry. Loring saw the skin of one of these shrews at Silverton. The National Museum has specimens from Black Hawk; Middle Park; Mount Elbert; and old Fort Massachusetts, near Fort Garland. Others from Crested Butte and Lake Moraine are in the Warren collection.

Corynorhinus macrotis pallescens Miller. Big-eared Bat.

Very little information is at hand regarding the range of the big-eared bat in Colorado. Thus far it appears to have been taken at only five localities, all of them along the eastern base of the foothills. A specimen in the collection of the Colorado Agricultural College, secured at Fort Collins by Mr. S. Arthur Johnson, has been identified by the Biological Survey. Miller records another specimen from Larimer County,[1] and Mr. A. E. Beardsley has taken two of these bats at Trinidad, according to Warren.[2] More recently Mr. R. T. Young has recorded a specimen collected in Boulder Canyon, at an approximate elevation of 7,000 feet.[3] Junius Henderson, curator of the museum of the University of Colorado, Boulder, informs me of the capture of a specimen in a tunnel at Crisman, Fourmile Canyon, Boulder County, at an altitude of 7,000 feet, by John J. Blanchard, November 1, 1909.

Nyctinomus mexicanus Saussure. Free-tailed Bat.

Four males of this austral species from Newcastle, Garfield County, have been identified for Warren, who states that he secured them along with a number of brown bats (*Eptesicus fuscus*), July 16, 1907, "behind a sheet-iron shutter on a building where they had gone for shelter during the day."[4] The elevation of Newcastle is 5,374 feet.

Nyctinomus has not been taken elsewhere within the State, or indeed anywhere in the neighboring parts of New Mexico, Arizona, and Utah. The Newcastle record is therefore a very great northward extension of known range for the Rocky Mountain region. The animal must reach this point from the southwest through the warm Grand Valley extension of the Colorado River Sonoran area; and it is noteworthy that this Lower Sonoran species should be found near the extreme upper edge of a narrow tongue of the Upper Sonoran zone, surrounded on all sides except the west by broad belts of boreal country. The occurrence of the free-tailed bat at Newcastle suggests that it may be found in the lowest and warmest valleys of the southwestern counties, particularly in the Grand Valley between Grand Junction and the Utah boundary, which is the lowest and most truly desert-like part of the Upper Sonoran area in western Colorado. Hitherto the northern known limit of range in the Colorado Valley has been Grand Falls, Arizona, in the valley of the Little Colorado.

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[1] N. Am. Fauna No. 13, p. 53, 1897.

[2] Mammals of Colorado, p. 267, 1906.

[3] Proc. Acad. Nat. Sci. Phila., p. 407, 1908.

[4] Further Notes on Mammals of Colorado, p. 85, 1908.

Nyctinomus depressus Ward. Tacubaya Free-tailed Bat.

Through Mr. E. R. Warren, of Colorado Springs, the Biological Survey has examined a Colorado specimen of this large free-tailed bat. Dr. S. M. Bradbury, of Grand Junction, who owns the specimen, says it was killed by some boys at Grand Junction about 1900. Warren has already placed this specimen on record.[1]

The type locality of *N. depressus* is Tacubaya, Federal District, Mexico. A few individuals have been captured in the desert areas of the southwestern United States, but the Grand Junction record extends the known range of the species far to the east and north.

Antrozous pallidus (LeConte). Pale Bat.

The pale bat occurs in several of the lowest and warmest Upper Sonoran valleys of extreme southwestern Colorado, but has not been reported from north of the Grand River Valley. An extreme record is that of a National Museum specimen taken at Pueblo, east of the mountains, since the species is largely restricted to the desert regions of the Southwest.

An excellent opportunity for observing this species was afforded at Ashbaugh's ranch, in the McElmo Canyon, 20 miles west of Cortez, in June, 1907. At dusk each evening numbers of these large bats appeared about the cliffs immediately north of the ranch, coursing in great circles above the upper rim rock in quest of insect prey. The large size, rapid sailing flight, and slow wing beats made these bats most conspicuous in contrast with the hosts of small *Myotis* and *Pipistrellus* which darted about in the gloaming in jerky, erratic flight. The majority of the pale bats flew so high as to be out of gun range from the base of the cliffs, but I managed to shoot two females on the evening of June 21. These bats were rarely observed about the ranch buildings, and invariably appeared first over the cliffs in the early twilight. Although none were seen actually emerging from the cliffs, the numerous cracks and crevices doubtless formed their retreat during the day.

In the deep canyon of Tabeguache Creek, north of Nucla, Montrose County, six or eight pale bats flew about the cliffs at a considerable height above our camp in the gathering twilight, July 19. They appeared in companies of two and three and coursed about with characteristic steady, rapid flight. I have observed this species at the following two points in the Grand River Valley, a single individual at each locality: In the rock-walled canyon of Plateau Creek, 5 miles east of Tunnel, Mesa County, September 30, 1906; and among the cliffs along Grand River, 7 miles west of Rifle, August 14, 1907. Neither bat was collected, but identification was reasonably positive. A large light-colored bat, apparently *Antrozous*, is commonly reported from the Grand River Valley near Crevasse, Mesa County, where it is said to live in ranch buildings.

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[1] Mammals of Colorado, p. 268, 1906.

The first recorded instance of the capture of *Antrozous* in Colorado is that given by Coues and Yarrow of a specimen taken at Pueblo by W. D. Wheeler in October, 1874, and deposited in the United States National Museum.[1] Dr. F. W. True informs me that this specimen, which appears to have been mummified, was destroyed about 1905, but that the skull is preserved.

Myotis subulatus (Say). Say Bat.

Vespertilio subulatus Say, Long's Exped. to Rocky Mts., II, p. 65, 1823. Type from Arkansas River, near La Junta, Otero County, Colorado.

Warren records two specimens of the Say bat from Colorado Springs.[2] These and the type appear to be the only Colorado specimens of this widely distributed species known at the present time. The species should be present over much of eastern Colorado.

Myotis lucifugus longicrus (True). Long-legged Bat.

This western form of the little brown bat is not uncommon in western and southern Colorado. One shot at Steamboat Springs as it was flying over Bear River at dusk August 1, 1905, is lighter colored than normal *M. longicrus*. Two others in grayish pelage were secured on the White River meadows, a few miles east of Meeker, August 12. At the last locality large numbers of these bats were flying over White River late in the evening. A dark female was collected at Coventry August 1, 1907, in my bedroom at 2 a. m. This form is also represented in the Biological Survey collection by a specimen from Grand Junction, collected June 23, 1893, by Mr. J. Alden Loring; and another collected on Conejos River, west of Antonito, by Mr. James H. Gaut, September 4, 1904.

Three specimens from the eastern part of the San Luis Valley have been identified recently for Warren. Two were collected above Herard, in Madenos Canyon, Saguache County, at an elevation of 8,700 feet, July 12, 1909. A third, from the Medano Springs ranch, east of Mosca, June 22, 1909, has distinct whitish edgings to the uropatagium, and is altogether paler than normal *longicrus*. Young records a mutilated skin in the collection of the Academy of Natural Sciences, Philadelphia,[1] from Eldora, in the high foothills of Boulder County.

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[1] Explorations W. of 100th Meridian, V, p. 85, 1875.

[2] Mammals of Colorado, p. 267, 1906.

Myotis evotis (H. Allen). Long-eared Bat.

The long-eared bat has been taken on both sides of the mountains in the Upper Sonoran zone, and a specimen recently recorded by Mr. R. T. Young from an elevation of nearly 7,000 feet, in the Steamboat Springs region,[1] shows that the species occasionally ranges into the Transition zone.

A series of 11 specimens was collected at the old L7 ranch, a few miles southeast of Sunny Peak, Routt County, in August, 1906. The bats had their abode in the deserted ranch house, and numbers could be seen flying in and out of the open doorway at dusk. I secured the specimens by entering the house after nightfall with a candle. Some were caught with an insect net, while others were knocked down with a hat. The above series presents considerable color variation, due largely to age. Three are immature and in gray pelage, but the majority are light yellowish brown. In 1907 this species was tolerably common at Ashbaugh's ranch, in the McElmo Canyon, Montezuma County, from June 20 to 23, where two were caught in the house after dark. One which flew into a house at Dolores the evening of June 27, I captured with my hand. At Coventry this was the most abundant bat about the ranch buildings in July. Five were caught in a house after dark July 24 as they flew in at the open window, attracted by the light. I have not taken this bat about rocky ledges and cliffs, and it appears to frequent mainly houses and outbuildings. Nearly all the above specimens are females. Specimens from Loveland have been recorded by Miller.[2]

Myotis yumanensis (H. Allen). Fort Yuma Bat.

This pale southwestern species is at present known in Colorado only from western Routt County, but eventually may be found at other points along the western border of the State, in the Upper Sonoran zone. It is represented by two females from Snake River, south of Sunny Peak, August 28, 1906; and a male from near Lily, at the confluence of the Snake and Bear Rivers, September 9, 1906. I secured these bats in deserted ranch buildings after nightfall, where they were not at all common, being greatly outnumbered by *M. evotis*.

The above specimens accord well in color with typical *yumanensis* from Fort Yuma, California, but have a somewhat longer forearm and foot.

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[1] Proc. Acad. Nat. Sci. Phila., p. 408, 1908.

[2] N. Am. Fauna No. 13, p. 80, 1897.

Myotis californicus (Aud. and Bach.). Little California Bat.

This small bat has been taken thus far at several widely separated localities in southern and western Colorado, and east of the mountains is known from two points in the Arkansas Valley and from Boulder Canyon. Its zonal distribution appears to be mainly Upper Sonoran.

In the McElmo Canyon, Montezuma County, it was apparently common in June, 1907, and I shot two at dusk as they were flying about the rocky cliffs north of Ashbaugh's ranch and caught another by lamplight in the house after dark. Another was captured in a house in the Grand Valley near Morris, 7 miles west of Rifle, August 14. An adult male from the San Luis Valley, 7 miles east of Antonito, Conejos County (8,000 feet), September 1, 1904, was taken by Mr. James H. Gaut. Small bats which I saw at Pagosa Springs May 28, 1907, and at the Paradox crossing of Dolores River July 7 were probably *M. californicus*. Specimens in the Warren collection from Bedrock (Montrose County), Salida, and Van Andert's Spring on Little Fountain Creek (El Paso County) have been examined by the Biological Survey.

Specimens of *M. californicus* from the highest elevations—Salida, Van Andert's Spring, Antonito, and Rifle—are almost as dark as typical *californicus*. Others from Ashbaugh's ranch and Bedrock, in the low desert valleys of southwestern Colorado, are considerably paler, agreeing precisely in coloration with specimens in the Biological Survey collection from the deserts of Arizona and Nevada. They are not as pale, however, as *M. c. ciliolabrum*.

Since the above was written Mr. Junius Henderson has written to me as follows: "Two specimens of *Myotis californicus* were taken in Marchioness Tunnel, Boulder Canyon, altitude 6,200 feet, by John J. Blanchard, December 22, 1909, thus making a winter record. I did not see these two bats until some ten minutes, perhaps, after he took them, when one of them was squealing viciously, but the other was quiet. In the warm cabin the former soon began to fly about the room. Supposing the winter habits of the animals here to be well known, Blanchard made no particular examination of them when he found them, but says he believes they were dormant, which is my impression from the condition of one of them when it reached me. The further fact that this tunnel, unlike some, does not seem to be infested with insects or other food for bats would tend to confirm the idea of hibernation. Possibly the temperature may give you some light on that subject. At the breast of the tunnel, where the bats were taken, about 350 feet back into the mountain, the temperature was soon after measured and found to be 46° F."

Myotis californicus ciliolabrum (Merriam). Hairy-lipped Bat.

The only western Colorado specimens of this small pale form of *M. californicus* appear to be two females from the old L7 ranch on Snake River, a few miles southeast of Sunny Peak, Routt County, taken August 28 and 29, 1906. Both the above bats I secured in the deserted ranch buildings after nightfall. This form was uncommon at that locality, being greatly outnumbered by *M. evotis*. In June, 1909, I found the hairy-lipped bat abundant in the badland cliffs at Chimney Canyon, some 30 miles northwest of Sterling. It appeared to be the common bat at this point, outnumbering *Eptesicus*, the only other bat seen, fully 10 to 1. Two were shot as they issued from the cliffs at dusk to feed on insects in the bottom of the canyon.

Pipistrellus hesperus (H. Allen). Western Bat.

These diminutive black-eared bats—the smallest species found in the State—inhabit the Upper Sonoran zone in the western and southwestern valleys. So far as my observations go, they live only about cliffs and in rock-walled canyons, where soon after sunset they issue in large numbers from the rocky ledges, and with rapid, erratic flight dart about in their nightly quest for insects, appearing in the gloaming like large moths. Aside from its small size, *P. hesperus* in flight may be easily distinguished by the very narrow wings.

In the lower McElmo Canyon, Montezuma County, I found this the most numerous species in June, 1907, and it was common also in the canyon of Tabeguache Creek, north of Nucla, Montrose County, in July. One was seen flitting about the cliffs on Grand River, 7 miles west of Rifle, August 14. At early dawn, October 1, 1906, a very small bat, which I took to be this species, flew over our camp beneath the steep cliffs in the canyon of Plateau Creek, 5 miles east of Tunnel, Mesa County.

There are seven Colorado specimens of *P. hesperus* in the Biological Survey collection, all females: One each from Ashbaugh's ranch (near McElmo), June 21, and Tabeguache Creek, July 19, 1907; four from Grand Junction, June 22 and 23, 1893; and another from Rifle, August 25, 1908. Warren has this bat from Bedrock, Montrose County.

Eptesicus fuscus (Beauvois). Brown Bat.

The common brown bat has a wide distribution and probably occurs over the whole State, except in the higher mountains above the Transition zone. One was shot near Steamboat Springs, Routt County, in August, 1905, as it was flying over Bear River; while later in the same month another was secured on White River, a few miles east of Meeker, Rio Blanco County. Bats which appeared to be *fuscus* were seen flying in McElmo Canyon, Montezuma County, in June, 1907, and others over the Dolores River in Paradox Valley, July 7.

This bat has been recorded by Miller from Loveland,[1] and by Allen from Florida, La Plata County.[2] According to Warren, Mr. A. E. Beardsley reports it common at Greeley.[3] More recently Warren mentions taking a specimen at Douglas Spring, Routt County, 1 at Colorado Springs, and 21 at Newcastle, and says: "Only one of the brown bats [Newcastle series] was a male, all the rest being females, one of the latter having a small young one attached to a teat. This was on July 16, 1907. The Douglas Spring specimen, taken June 26, contained a single good-sized embryo."[4] *E. fuscus* has also been taken in Boulder Canyon, at about 7,000 feet, according to Young.[5] All the above localities are in the Upper Sonoran zone or in the Transition zone.

Considerable color variation is shown by specimens of *E. fuscus* from different parts of Colorado, some being as dark as normal and others much paler. A specimen in the Biological Survey collection from the Chimney Bluffs, some 30 miles northwest of Sterling (June 7, 1909), is the only one examined, however, which shows a near approach to the extremely pale coloration of *E. f. pallidus.* Although nearly as pale as *pallidus,* this specimen has the measurements of *fuscus,* to which it is referred. Another specimen from Steamboat Springs has the dark coloration of *fuscus,* but in large size approaches *pallidus.*

Eptesicus fuscus pallidus Young. Pale Brown Bat.

Eptesicus pallidus Young, Proc. Acad. Nat. Sci. Phila., p. 408, 1908. Type from Boulder, Colorado.

The exact status of this peculiar large pale bat will not be known until much additional material is received from the plains region of eastern Colorado. The type from Boulder in the National Museum is larger than *fuscus,* and is very pale. It measures: Total length, 127; tail, 50; hind foot, 12. Other specimens from Boulder, the measurements of which are given in the original description (l. c.), are nearly as large as the type. The skull of the type is like that of *fuscus,* only larger, being about the size of *E. miradorensis.* The type of *pallidus* can be closely matched in size by a dark specimen of *fuscus* from Steamboat Springs, and in pallid coloration by a smaller individual from the Chimney Cliffs, northwest of Sterling.

Mr. Junius Henderson, curator of the museum of the University of Colorado at Boulder, writes me of the recent capture of three additional specimens of *E. f. pallidus* at Boulder. Warren, who has examined these bats, says that they are paler than his specimens of *E. fuscus* and agree in measurements with the type of *pallidus.*

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[1] N. Am. Fauna No. 13, p. 98, 1897.

[2] Bull. Am. Mus. Nat. Hist., V, p. 83, 1893.

[3] Mammals of Colorado, p. 268, 1906.

[4] Further Notes on Mammals of Colorado, p. 85, 1908.

[5] Proc. Acad. Nat. Sci. Phila., p. 409, 1908 (footnote).

Lasionycteris noctivagans (LeConte). Silver-haired Bat.

During the breeding season the silver-haired bat is probably restricted largely to the Canadian zone in Colorado, as it is elsewhere in North America, but specimens taken in both the Transition and the Upper Sonoran zones indicate that at certain seasons it performs vertical migrations of some extent.

One evening in August, 1905, while encamped at the Widows Corral, on the White River Plateau, 25 miles southeast of Meeker, I obtained frequent glimpses of a small bat flitting about in the aspen forest. It flew so near the ground that its course was very difficult to follow in the fast-gathering twilight, but it was shot and proved to be a specimen of the silver-haired bat. This locality is in the Canadian zone, at 8,500 feet. The Biological Survey has a specimen of this bat from Rifle, Garfield County, collected by Loring in 1893; while a specimen taken by Dr. Elliott Coues in North Park at 10,000 feet, September 16, 1876, is in the National Museum.

Warren has specimens from Green Mountain Falls, Newcastle, and Salida, and records the species from Glen Eyrie (near Colorado Springs) and Greeley.[1]

Mr. Junius Henderson informs me by letter of the capture of a specimen at Boulder June 6, 1909.

I did not meet with this bat in southern Colorado, but it has been recorded from Florida, La Plata County, where Charles P. Rowley collected two specimens in 1892.[2]

Nycteris cinereus (Beauvois). Hoary Bat.

The large hoary bat has been taken only a few times in the State, and consequently its local distribution is not well known. The normal breeding range is in the Canadian zone, and therefore it may be expected to breed in the mountains. Thus far, however, specimens have been collected only in the eastern foothills and along their immediate eastern bases and in the lower valley of Grand River. A mounted specimen owned by Dr. S. M. Bradbury, of Grand Junction, taken at that locality, has been examined, and there is a specimen in the Merriam collection from Boulder County, secured by the late Mr. Denis Gale September 16, 1889. Miller records three specimens from Larimer County.[3] Warren quotes the statement of Mr. A. E. Beardsley that this bat is "frequent at Greeley,"[4] and states in a recent letter that it has been taken at Salida and Boulder.

Nycteris borealis (Müller). Red Bat.

Biological Survey collectors have not met with this species in Colorado, although it should be found over the eastern plains region. The only record seems to be that of Mr. A. E. Beardsley, who says the red bat is rare at Greeley.[5]

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[1] The Mammals of Colorado, p. 277, 1910.

[2] Allen, Bull. Am. Mus. Nat. Hist., V, p. 83, 1893.

[3] N. Am. Fauna No. 13, p. 114, 1897.

[4] Mammals of Colorado, p. 268, 1906.

[5] Warren, Mammals of Colorado, p. 268, 1906.

PRINCIPAL TREES AND SHRUBS OF COLORADO.

The explorations of the Biological Survey in Colorado have resulted in the accumulation of valuable notes on the distribution of many species of plants, and those relating to the trees and shrubs are brought together in the following briefly annotated list. No attempt is made to give a complete list of Colorado trees and shrubs, and the species included are chiefly those whose known ranges in the State have been considerably extended by the work of the Biological Survey. Several of these apparently have not been recorded previously from the State. Most of the specimens collected have been identified by the botanists of the United States National Museum.

The nomenclature followed is mainly that of Dr. Rydberg in his Flora of Colorado (Bull. 100, Colo. Agr. Exper. Station, 1906). Distribution notes relative to a number of species of restricted range are taken from this publication and, to avoid repetition, are unaccompanied by references.

Pinus aristata. Foxtail Pine.

The foxtail pine is a characteristic timberline tree on parts of the Front, Kenosha, Saguache, and Sangre de Cristo Ranges, but was not observed on the mountains of western or extreme northern Colorado. On the Sangre de Cristo Range the southern limit appears to be near Crestone Peak, but I again encountered it on the high Culebra Range southwest of La Veta. On the Saguache Range it was found south to a point northwest of Villa Grove, and scattering trees were observed at timberline on the San Juan Mountains northeast of Pagosa Springs. None of these pines were seen on the Front Range north of James Peak. Foxtail pines are most abundant on the Saguache Range near St. Elmo and in the Grays Peak region. A straggling and dwarfed growth fringes the exposed ridges on both sides of Clear Creek Valley above Silver Plume, between 11,000 and 11,500 feet.

Although largely confined to the timberline region between 11,000 and 12,000 feet, and perhaps more nearly restricted to the Hudsonian zone than any other tree in the State, the foxtail pine is occasionally found on bare exposed ridges as low as 9,500 feet. Near Como it is common on many of the ridges bordering South Park at 10,000 feet. Between Clyde Station and Cheyenne Mountain on the Cripple Creek Short Line Railway the species forms a considerable forest. At this point the pines are very regular in shape, few are branched near the base, and many are 30 feet high. In the timberline region the trees are usually under 15 feet in height, dwarfed and ragged, and the majority are much branched. (See Pl. XI, fig. 1.) At a distance they greatly resemble a ragged growth of juniper (*Juniperus monosperma*), and are in marked contrast to the more symmetrical Engelmann spruces, which usually share the bleak timberline slopes with them. Foxtail pines usually grow on slopes having warm south or west exposures and very rarely on cool slopes. This species forms the highest recorded timberline in the State (12,300 feet), near St. Elmo, on the Saguache Range.

Pinus flexilis. Rocky Mountain White Pine.

This small, bushy, much branched pine has a general but very scattering distribution in the mountains of northern Colorado, at elevations between 7,000 and 10,000 feet. Like the foxtail pine of the timberline regions, which it greatly resembles, *P. flexilis* usually grows along the crest of bare, outlying, gravelly ridges, and owing to its wind-swept location usually grows straggling and one-sided. It is most abundant on the open mountain slopes east of Fall River, Clear Creek County, on the ridges of the South Park region, and on the mountains east of Laramie River, but was noted at other localities as follows: McIntyre Creek, east slope of Medicine Bow Range; outlying ridges north of Higho and east of Canadian Creek, North Park; Hahns Peak (8,500 feet); bluffs north of Snake River, 8 miles east of Slater; Grand River Canyon, east of Glenwood Springs; Empire; canyon on Grand River, west of Hot Sulphur; and valley of South Boulder Creek. The species does not attain its maximum size in northern Colorado, and no trees more than 30 feet high were observed.

P. flexilis was found at but few localities in the southern mountains in 1907. Groves of considerable extent are on the partially open slopes at the head of Wahatoye Creek, between the Spanish Peaks and the Culebra Range, at about 9,000 feet elevation, and the species is common throughout the La Veta region. A much larger growth is attained here than farther north, many of the trees reaching a height of 50 feet. This pine is not uncommon at Pagosa Springs, between Needleton and Silverton, on the Rio Grande bluffs below Wagon Wheel Gap, and at Divide.

Pinus scopulorum. Rocky Mountain Yellow Pine.

The yellow pine is a characteristic tree in the foothills of all parts except northwestern Colorado. The eastern foothills of the Medicine Bow and Front Ranges are clothed with a scattering growth from their bases to the lower edge of the lodgepole pines at 8,000 or 9,000 feet, the heaviest forests being west of Loveland, on the western end of the Arkansas Divide, and in the South Platte region. Farther south there is a good stand on the Wet Mountains, becoming heaviest in northwestern Huerfano County and continuing southward in a well-defined belt along the eastern foothills of the Sangre de Cristo and Culebra Ranges. On the lower mountain slopes bordering San Luis Valley the pines are restricted to narrow interrupted belts, which converge at its northern end and connect over Poncha Pass with the pine country along the Upper Arkansas.

West of the Continental Divide, *P. scopulorum* is largely restricted to the region south of the Grand and Gunnison Rivers. Stately forests of great extent occupy the southern and western slopes of the San Juan, La Plata, and San Miguel Mountains, and the eastern slopes of the La Sal Mountains, ranging between 6,500 and 8,500 feet, and a moderately heavy growth extends to the northwestern end of the Uncompahgre Plateau. In the Gunnison country yellow pines are very local and scattering, except in the valley of the Lake Fork, where they are tolerably common. In northwestern Colorado they are rarely seen, and occur in widely separated areas of small extent as follows: Medicine Bow Mountains, east of Canadian Creek, North Park, lowest outlying spurs, 8,800 feet; north slope of Elk Head Mountains, 20 miles southeast of Slater, rocky exposed ridges, 7,800 feet; Grand River Canyon to 6 miles west of Glenwood Springs; southwest slope 8 miles north of McCoy, Eagle County, 7,800 feet; and on the summits and northern slopes of the Escalante Hills, in western Routt County, where there is a tolerably heavy growth between 6,400 and 7,500 feet.

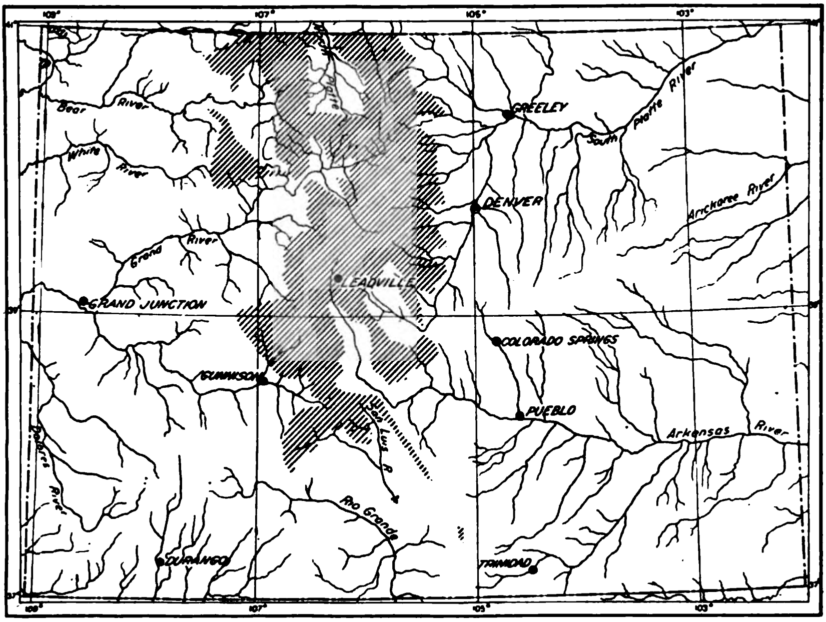

FIG. 30.—Distribution in Colorado of lodgepole pine (*Pinus murrayana*).

In the eastern and northern mountains the yellow pines seldom attain large size, and in rocky situations they are often quite scrubby. In the southwest, however, particularly in Archuleta County, there are as large trees and handsome forests as can be found in any of the Rocky Mountain States. Lumbermen have exhausted some of the best pine forests of southwestern Colorado, but there still remain large areas, and fortunately these are now largely included in the San Juan and Montezuma National Forests.

Pinus murrayana. Lodgepole Pine.

A broad belt of magnificent lodgepole pine forest with a vertical breadth averaging 2,000 feet occupies the middle slopes of the high mountain ranges of northern Colorado between 8,000 and 10,000 feet. (See fig. 30.) This forest clothes the summits of the Laramie Divide and of the lower parts of the Medicine Bow, Park, and Gore Ranges. Farther south this pine covers an extensive area on the Saguache Range and on the mountains of the Gunnison country. The southern limit is reached on the Continental Divide at the head of the Saguache River. On the Sangre de Cristo Range a narrow belt extends south along the eastern slope as far as Crestone Peak, but the species appears to be entirely absent from the western slope of the same range. A few of these pines are found on the summit of Veta Pass—the southernmost point at which the species is known to occur within the State.

The heaviest and purest forests of lodgepole pines were traversed on the high divide east of Laramie River and on the Park and Gore Ranges, at an elevation of about 9,500 feet. (See fig. 31.) On most of the ranges, however, the pines are mixed with aspens below 9,500 feet and with Engelmann spruces above 10,000 feet.

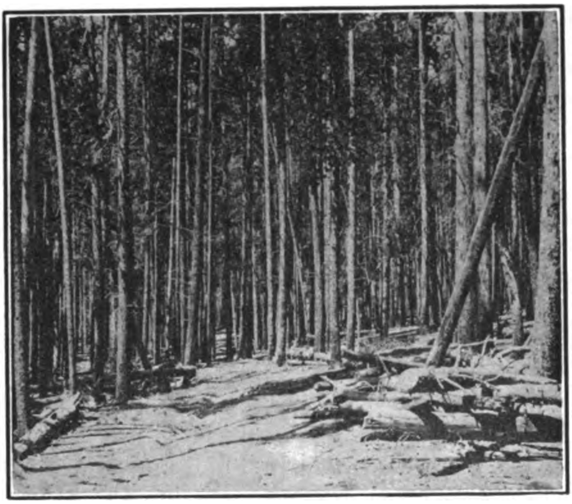

FIG. 31.—Forest of lodgepole pines (*Pinus murrayana*), eastern slope of Park Range, west of Pearl, at 10,000 feet.

To the west *P. murrayana* is the common forest tree in the Elk Head Mountains and in the region bordering Egeria Park, but on the White River Plateau it does not extend far west of the South Fork of White River. A scattering growth is reported on Diamond Peak and Mount Cullom, on opposite sides of Green River in extreme northwestern Routt County. The lowest elevation reached within the State appears to be on the northern slope of the Elk Head Mountains near Honnold, where narrow tongues descend to the bank of

Snake River at 7,000 feet. The extreme upper limit on the Boreas Pass is on a southwest slope at a little over 11,000 feet. This pine appears to be absent from the mountains of southwestern Colorado.

The lodgepole pine is very largely restricted to the Canadian zone. In the mountain districts of central Colorado much of the best growth has been used for mining timbers, and farther north lumbering operations have depleted large tracts. At present a young and dense growth covers much of these areas, which are practically all included in National Forests.

Pinus edulis. Pinyon; Nut Pine.

The pinyon is found in abundance in the rough country of western and southern Colorado at elevations varying from 5,000 to 7,500 feet. It clothes the rocky slopes and bluffs bordering the river valleys and forms a dense growth on most of the rough intervening watersheds and mesas. In the mountains of the San Luis Valley region the pinyon belt reaches an elevation of 9,000 feet on warm slopes.

This small pine is fully as common in the Upper Sonoran zone as *Juniperus monosperma*, and marks this zone over extensive areas. In many localities, however, it enters the lower edge of the Transition zone, where it commingles to a certain extent with yellow pines and Douglas spruces. It is nearly always associated with the juniper (*Juniperus monosperma*) below 7,000 feet.

A very dense growth of pinyon covers the Mesa Verde and practically all the broken country from Montezuma County north to Mesa County. A heavy and continuous belt is found on the lowest flanks of all the mountains from the San Juans north to the Book Cliffs, and in the Grand River Valley the species extends eastward as far as McCoy, Eagle County. North of the Book Cliffs the distribution is more restricted, as follows: Evacuation Creek Valley up to 7,000 feet on north slope of the Book Cliffs; heavy growth in Pinyon Valley and on the Rabbit Hills; divide between Bear and White Rivers, south of Lily, to 6,000 feet; Escalante Hills, dense growth on north slopes at 6,400 to 7,000 feet; scattering growth southwest slope of Cross Mountain, and also on south slope of O-wi-yu-kuts Plateau. Pinyons are found on most of the mesas and ridges of the San Luis Valley region, and form heavy belts on the lower bordering mountain slopes north as far as Villa Grove. On the eastern slope of the mountains they occur regularly north to Manitou, and follow up the warm Arkansas Valley to considerably above Buena Vista, the growth being especially dense and extensive on the head of Huerfano River and in the adjacent country. The species reaches its eastern limit in Colorado, and probably in the United States, in Las Animas County, where a considerable growth is found on Mesa de Maya and on other high points in that rough region.

Picea engelmanni. Engelmann Spruce; White Spruce.

The stately Engelmann spruce forms a heavy forest belt just below timberline on all the higher mountain ranges, and in a dwarfed state is common at timberline. At this elevation it occurs in prostrate mats 1 to 3 feet in height and often 8 or 10 feet in diameter. Its greatest development is reached along the upper edge of the Canadian zone, where the spruce forest is either pure or mixed with balsam firs, many of the trees being 3 or 4 feet in diameter and 100 feet in height.

The heaviest spruce forests were on the Park, Medicine Bow, and Saguache Ranges, in the San Juan Mountains, and on both slopes of the Front Range from Rollins Pass south to Berthoud Pass. A moderate growth of Engelmann spruce is found on the Uncompahgre and White River Plateaus, on Grand Mesa, and on other high plateaus of western Colorado.

The upper limit of the Engelmann spruce varies with timberline from 11,000 to 12,000 feet. The vertical width of the belt depends much upon the steepness of slope, averaging between 1,000 and 1,500 feet on gradual slopes, but often narrowing to 500 feet, as is the case just below timberline on a steep southwest exposure south of Berthoud Pass. Below 10,000 feet *P. engelmanni* occurs only in damp situations on cold slopes and in descending tongues along streams, usually embraced by heavy forests of lodgepole pine or aspen. It is found as low as 8,200 feet along Pass Creek, on the eastern slope of the Park Range; while on the mountains east of Laramie River it occurs at 8,500 feet. Scattering trees occur on Middle Boulder Creek, 5 miles west of Boulder, at 6,000 feet, but this low elevation is abnormal.

Picea parryana. Blue Spruce.

The blue spruce has a very scattering distribution in the lower part of the Canadian zone on both slopes of the main ranges. In northern Colorado in 1905 and 1906 small clumps and single trees were noted here and there along streams at elevations of from 7,000 to 8,500 feet, as follows: West of Log Cabin, Larimer County, 7,500 feet; Nederland, 8,200 feet; South Boulder Creek; northeast base of Floyd Hill; Empire; Idaho Springs; Fall River, Clear Creek County; south slope of Park Range; north of Hahns Peak, 8,500 feet; Snake River bluffs; Honnold to 8 miles east of Slater; north slope of Piney Divide, south of McCoy, 7,500 to 8,000 feet; Pass Creek, northwest of Kremmling; Eagle River, Dotsero to Wolcott; and canyon of the Grand east of Glenwood Springs. In the mountains of southern Colorado the blue spruce has a general distribution between 8,500 and 9,500 feet, being much more common than farther north.

This species is apparently never found away from the immediate vicinity of streams,[1] all the trees that I have observed growing either on the banks of watercourses or on the nearest benches. It probably belongs to the Canadian zone, but in common with many other boreal species finds a suitable environment in the cool conditions which obtain along streams well down into the Transition zone. The characteristic scattering distribution of the blue spruce along watercourses is best seen along Eagle River between Wolcott and Dotsero, on the Frying Pan River, and on the many streams of Clear Creek County.

Pseudotsuga mucronata. Douglas Spruce; Red Fir.

The Douglas spruce is of comparatively small size in Colorado. The largest trees are found along watercourses, where a height of 100 feet and a diameter of 3 or 4 feet are occasionally attained. The average growth, however, is less than a third of these dimensions, especially among the eastern foothills.

The species has a general distribution in the mountain districts, being most abundant on the eastern slopes of the Medicine Bow and Front Ranges and on the plateaus and higher mesas of western Colorado. It is mainly a Transition zone tree, but occurs commonly in the lower Canadian zone also, particularly in the western mountains.

On the eastern slopes of the main ranges the Douglas spruce is occasionally found along streams as low as 5,800 feet. In the upper part of the yellow pine belt it occupies most of the steep north slopes between 6,000 and 8,000 feet. Near Fall River, in Clear Creek County, it extends up southwest slopes to the 9,000-foot summits of hills, whose northeast exposures are clothed with lodgepole pines and aspens. The Douglas spruce thus occupies a position intermediate between the yellow and lodgepole pine belts east of the Continental Divide. Over most of western Colorado it is found just above the pinyon belt, largely replacing the yellow pine in the Transition zone, and with the aspen clothing the Canadian zone summits and upper northern slopes of the plateaus and higher mesas. (See fig. 32.) On the crest of the Uncompahgre Plateau and elsewhere it grows at an elevation of over 10,000 feet.

The following localities indicate the distribution of *Pseudotsuga* in northwestern Colorado: North slope of Piney Divide, south of McCoy, 7,000 to 8,000 feet; south slopes of mountains north of McCoy, 8,000 to 8,500 feet; mountains south of Eagle; canyon of the Grand above Glenwood Springs; Battlement Mesa; Great Hog Back;

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[1] At Saguache and elsewhere these handsome spruces grace many dooryards, where they have been planted. As an ornamental tree the blue spruce has few equals.

southern slopes of White River Plateau; Grand Mesa; high country on both sides of Grand River between Glenwood Springs and Grand Junction, at elevations ranging from above 6,000 feet on cold slopes to 7,000 or 8,000 feet on warm slopes; Book Cliffs, heavy growth on north slope near Baxter Pass, 7,000 to 8,500 feet; hills bordering Evacuation Creek Valley; sparse growth on northeast upper slopes of Rabbit Hills; and Zenobia Peak, scattering growth reported. In southwestern Colorado I observed the species as follows: Southern slopes of La Plata Mountains between Durango and Mancos in the Canadian zone; upper slopes of Ute Peak; steep upper rims of Sinbad and West Paradox Valleys (cool exposures); Unaweep Canyon; Cimarron; Vernal Mesa; West Elk Mountains east of Crawford; Roaring Fork of Grand River, Basalt to Aspen; Sapinero; and Lake City.

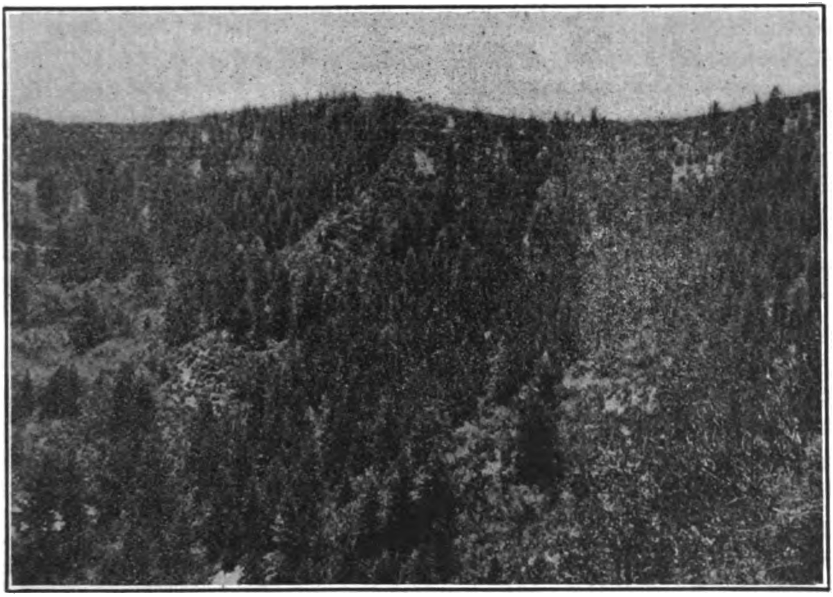

FIG. 32.—Pocket of Douglas spruce (*Pseudotsuga mucronata*) on northern escarpment of Mesa Verde, 7,500 to 8,000 feet.

Abies lasiocarpa. Balsam Fir.

The balsam fir is found throughout the Hudsonian zone and along the upper edge of the Canadian zone. It is not so uniformly distributed as the Engelmann spruce and does not form as extensive forests. Occasionally, however, its growth is heavy, as on the western slope of the Front Range in the vicinity of Rollins Pass and on the west side of the Saguache Range below Alpine Tunnel, where extensive forests were traversed between 10,000 and 11,000 feet.

In a dwarfed state this fir often extends up to extreme timberline with the Engelmann spruce. Its characteristic growth is in clumps and thickets scattered here and there through the spruce forest, and the smooth, light-colored trunks of the firs are very conspicuous among the dark spruces. Occasionally the species is encountered as low as 8,500 feet, and on the eastern slope of the Park Range northwest of Kremmling I found it growing along streams at 8,200 feet. It formed heavy thickets at 10,000 feet on the divide east of the Laramie River, and also on the Medicine Bow Range; and on the northern part of the Park Range it was common both on the Buffalo Pass and on the headwaters of Grand Encampment River. On the White River Plateau it was growing in dense thickets in the aspen forests between 8,500 and 9,000 feet, chiefly on northern exposures.

This tree appears to have fully as wide a range in southern as in northern Colorado, but the growth is smaller and more scattered toward the south. The species was observed in southern Colorado on the summit of the Uncompahgre Plateau, at Rico and Ophir, from Needleton to Silverton, and between Vance Junction and Sawpit.

Abies concolor. White Fir.

The white fir is found in the southern mountains, where it is usually common between 8,500 and 10,000 feet, in the lower Canadian zone. It does not occur far north of Colorado Springs on the eastern slope, and Ouray marks the northern limit west of the Continental Divide. The white fir forms considerable forests in the Wet Mountains and on the southern slopes of the San Juan Mountains north of Pagosa Springs, but usually the growth is somewhat scattering, and is restricted either to the vicinity of streams or to cool exposures, where the firs mingle with aspens. The largest trees observed were at 9,000 feet on the southwest slope of Pagosa Peak, where a height of 75 feet was not uncommon.

The white fir was noted at the following localities: Wet Mountains, east of Westcliffe, 9,000 feet; mountains between Canon City and Cripple Creek, above 8,500 feet; northern exposures on eastern slope of Sangre de Cristo Range near Sand Hill Pass, 9,000 to 9,500 feet; head of Wahatoye Creek, 9,000 feet; upper northern slope of Fisher Peak, south of Trinidad; mountains near Saguache; Animas Canyon, near Silverton; and lower mountain slopes surrounding Ouray.

Juniperus scopulorum. Rocky Mountain Juniper.

This juniper is common in the Upper Sonoran and Transition zones throughout the mountains, and also often forms the only coniferous growth in gulches and on rocky ridges and buttes on the higher plains of northeastern Colorado. It has an extreme vertical range within the State from 4,500 to 10,000 feet, and is most abundant in the higher foothills between 6,000 and 8,000 feet. I observed it at the following localities: Boulder; Golden; Platte Canyon Station; Pawnee Buttes; Bailey; Colorado Springs; La Veta; hills north of Canon City; Promontory Bluffs; bluffs east of Grover; Buena Vista; St. Elmo; Weston; Chimney Cliffs, northwestern Logan County; Book Plateau, sparingly above 7,500 feet; Glenwood Springs; Wolcott; McCoy; Ohio City; Gunnison; Sapinero; Lake City; Lone Cone; Beaver Mountain, Dolores County; Mancos; Mesa Verde, north escarpment; and Pagosa Springs.

Juniperus monosperma. Juniper.

This is the most abundant juniper in the State, and is a characteristic Upper Sonoran species. It forms a well-defined belt covering most of the lowest foothill slopes of western and southern Colorado and is prominent on the eastern foothills from the Arkansas Valley southward. A heavy growth covers a large area of rough canyon country in Las Animas and western Baca Counties, and many outlying ridges and buttes in Otero County are clothed with junipers. The species reaches a large size and dense stand on the Escalante Hills and other low elevations of western Routt County, and is abundant on Mesa Verde, in Montezuma County.

The vertical position of *J. monosperma* is immediately below the pinyon belt, although scattering junipers occur with the pinyons as high as 7,500 feet in southern Colorado. It is most abundant between 5,000 and 7,000 feet on arid slopes. The resinous one-seeded berries of this juniper are much used as food by chipmunks, wood rats, and other small rodents.

During my explorations in Colorado I have observed the species as follows: Slater; bluffs bordering lower Snake River Valley; Godiva Ridge; Cross Mountain; Escalante Hills; O-wi-yu-kuts Plateau, southern slopes; Vermilion Bluffs; watershed between Bear and White Rivers south of Lily; 5 miles southwest of Rangely to base of Rabbit Hills; northern and southern slopes of Book Plateau below 7,500 feet; hills south of Mack, Mesa County; lower slopes of Grand Mesa; northeast slope of Little Book Cliffs; De Beque to Glenwood Springs; bluffs along north side of Eagle River from Dotsero nearly to Wolcott; McCoy; Basalt; Somerset; Ridgway; Coventry; Placerville; western Montrose and San Miguel Counties; Mesa Verde; McElmo Valley; Salida; Canon City; Walsenburg; Pueblo; and Gaume's ranch, northwestern Baca County.

Juniperus sibirica. Low Mountain Juniper.

This beautiful procumbent shrub is conspicuous among the undergrowth of the forests in the Canadian and upper Transition zones, where it is almost omnipresent. It reaches its greatest abundance along the upper edge of the yellow pine belt at 8,500 or 9,000 feet. I have found it particularly common in the higher eastern foothills of the Front Range; on the forested ridges near Como, South Park; in the Wet Mountains east of Westcliffe; on the Sangre de Cristo Range in western Huerfano County; and at St. Elmo, Saguache Range, 10,000 feet.

Juniperus prostrata. Creeping Juniper.

The creeping juniper or savin appears to be uncommon in the Colorado mountains. I collected it on Lone Mesa, Dolores County, at 9,200 feet, June 26, 1907; and saw dense patches of it on open rocky ridges along Pass Creek, northwest of Kremmling, Middle Park, in October, 1906. Rydberg records it from North Cheyenne Canyon, Parlin, and Owl Canyon.

Ephedra antisyphylitica. Joint Fir.

The joint fir is a characteristic shrub on the warm rocky Upper Sonoran slopes of western Colorado, extending eastward with the junipers and pinyons for some distance into the mountains along the warm north sides of the river valleys. *E. antisyphylitica* is the common species of widest range, but two other forms are present in the southwestern valleys.

I have observed this joint fir at the following localities: Escalante Hills, 7,000 feet; White River bluffs east of Rangely; pinyon country southwest of Rangely; juniper-covered hills at north base of the Book Cliffs; Glenwood Springs; Basalt; Mesa Verde; McElmo; lower San Miguel and Dolores River regions (omnipresent below 7,000 feet); Placerville; and Coventry.

Ephedra torreyana.

I have taken this species only on the warm juniper slopes along the north side of North Gunnison River at Somerset, 6,000 feet. It is recorded by Rydberg from Deer Run, Mesa County.

Yucca glauca. Yucca.

This yucca is one of the most characteristic Upper Sonoran plants in the State, being almost omnipresent below 6,000 feet, and extending often to 8,000 feet on exceptionally warm slopes in the foothills. It occurs in abundance on both sides of the mountains (see fig. 33), but the densest growth is on the eastern plains, particularly in the southeastern counties. The tall spikes of greenish white flowers are very prominent on the plains during June.

Following are some of the localities at which *Yucca glauca* was observed on my trips over the State: Gaume's ranch, northwest Baca County; Limon; Cheyenne Wells; Tuttle; Wray; Sterling; Pawnee Buttes; Grover; east of Boulder; near Fort Collins; Bailey; Gardner; La Veta; Buena Vista; Wet Mountain Valley; Poncha Pass, summit; Salida; Cascade; Pueblo to Walsenburg; Saguache and San Luis Valleys generally; Gunnison; Hotchkiss; Montrose region; Placerville; McElmo Valley; lower Dolores River region up to 7,000 feet; Unaweep Canyon; Rifle; De Beque; Plateau Creek; and hills between Carbonera and Mack.

Yucca harrimaniæ. Harriman Yucca.

Locally common at several points in the juniper belt of southwestern Colorado below 7,000 feet. I found it in 1907 near Ridgway; on the slopes of Cerro Ridge east of Montrose; and on the rocky slopes along the west side of Sinbad Valley. Rydberg records the species from Cimarron and Durango.

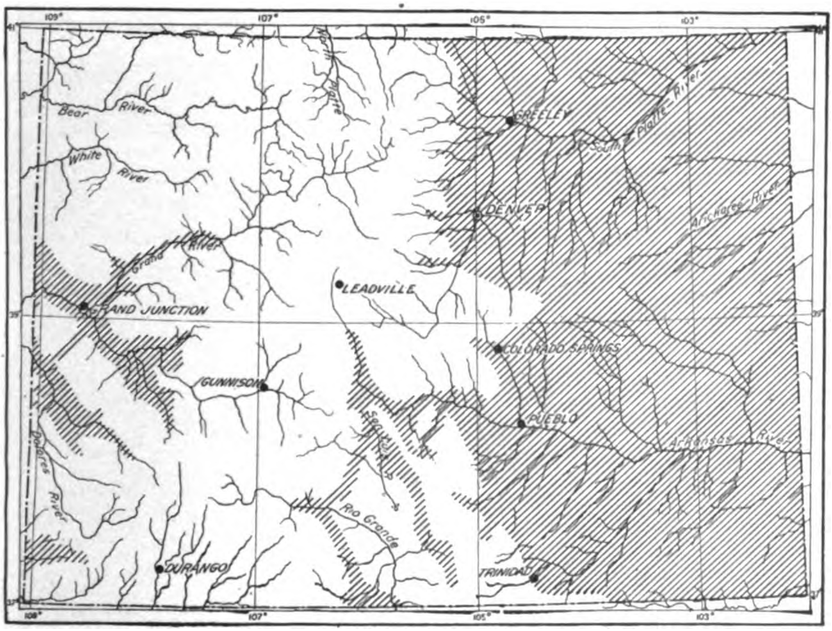

FIG. 33.—Distribution in Colorado of common yucca (*Yucca glauca*).

Yucca baccata. Spanish Bayonet.

This large-leaved yucca is a characteristic Upper Sonoran plant in parts of southwestern Colorado, growing chiefly among rocks on warm juniper slopes and in the lowest valleys. It was flowering on Mesa Verde at 7,000 feet June 13, 1907, the spikes of large greenish white flowers dotting the rocky rims of Navajo Canyon just above the Spruce Tree Cliff Ruins. (See fig. 34.) I observed this yucca at Arboles; Bayfield; McElmo; Coventry; on slopes bordering Paradox and Sinbad Valleys; and along the canyon of Dolores River between Salt Canyon and the mouth of West Creek. There appears to be only one Colorado record for *Y. baccata* east of the mountains—Rydberg recording it from Trinidad.

Populus tremuloides. Aspen; Poplar.

Extensive aspen forests clothe the summits and northern slopes of nearly all the western plateaus and mountains between 8,000 and 10,000 feet, but on the eastern slope of the main ranges the trees are usually small, and form dense thickets rather than open forests. This boreal poplar is restricted to the Canadian zone, the center of abundance being at about 9,000 feet. Small thickets sometimes occur on cold northeast slopes as low as 7,000 feet, while on warm southern slopes a dwarfed growth usually extends to at least 10,500 feet. The best aspen forests were encountered on the White River, Book, and Uncompahgre Plateaus, and on the north slope of the Rabbit Ear Mountains near Arapahoe Pass, where trees fully 2 feet in diameter and 50 feet in height were not at all uncommon. On the crest of the Uncompahgre Plateau, near its northern end, beautiful aspen groves alternate with reaches of open grassy country, the coniferous element so common elsewhere being very largely absent. The aspen forest is often tolerably clear of large undergrowth, but is mixed here and there with thickets of balsam firs or lodgepole pines. Throughout the mountains are areas which formerly supported coniferous forests, but have been devastated by forest fires.

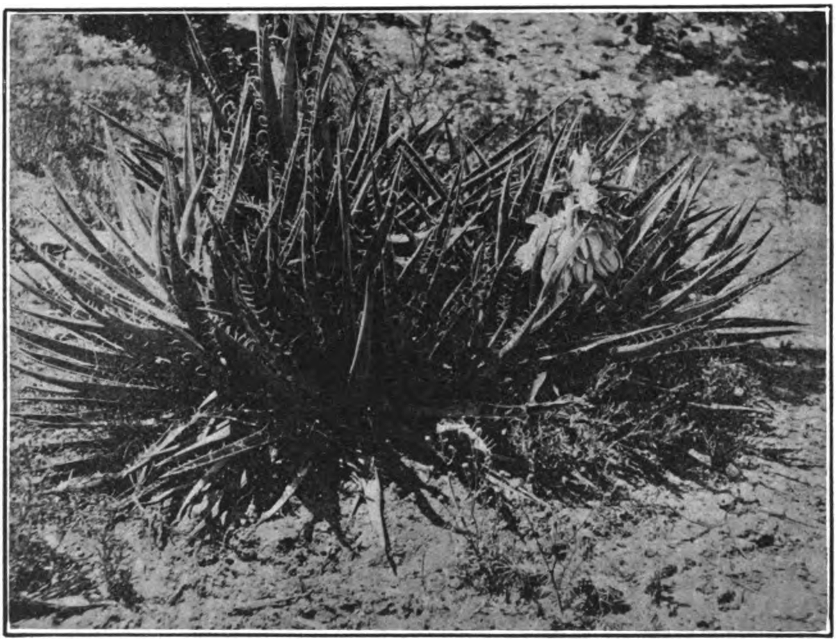

FIG. 34.— *Yucca baccata* in flower, Navajo Canyon, Mesa Verde.

These are now mostly covered with a young growth of aspens, which seem to secure a foothold much more quickly than any of the conifers.

Populus angustifolia. Narrow-leaf Cottonwood.

There is scarcely a foothill stream in the State which is not fringed with more or less of these cottonwoods. It is a characteristic Transition zone species, with a vertical range from 5,500 to about 9,000 feet. Its vertical position is intermediate between the aspen of the Canadian zone and the broad-leaved cottonwoods of the Upper Sonoran zone. It attains its largest size along the lower edge of its range at the base of the foothills, where it often mingles for a short distance with the broad-leaved species. Scattered clumps of large size are found the entire length of the Snake River Valley, in northwestern Colorado.

Populus occidentalis. Broad-leaf Cottonwood.

This is the cottonwood which fringes most of the streams on the eastern plains, the heaviest and largest growth being found along the Platte and Arkansas Rivers and on many of the streams near the base of the foothills from Denver north to Fort Collins. The growth is particularly large in the Arkansas Valley between Las Animas and the Kansas boundary. It is found on only a few streams in the foothills, but near Livermore, Larimer County, I found it up to 6,000 feet along Lone Pine Creek, and a single tree was growing on Middle Boulder Creek at 5,800 feet. On the dry plains of Baca County the beds of the streams, few of which are perennial, are fringed by a gnarled and stunted growth of cottonwoods.

Populus wislizeni. Southwestern Cottonwood.

This is the predominant broad-leaved cottonwood of southwestern Colorado, where it occurs along most of the watercourses below 6,000 feet. I found it common at Arboles; Grand Junction; along McElmo Creek; on San Miguel River below Naturita; Dolores River between Paradox Valley and the mouth of West Creek; Smith Fork below Crawford; and North Gunnison River to 5 miles below Somerset; and it was probably the species growing along the Rio Grande at Alamosa. East of the mountains it is found on the plains at Colorado Springs, according to Rydberg.

Populus acuminata. Smooth-bark Cottonwood.

During my explorations in Colorado I observed this cottonwood only in the Upper Sonoran stream valleys of the northwestern counties from the Wyoming boundary south to Mesa County, as follows: Scattering fringe along Snake River for 8 miles above Lily; dense growth of large size on Green River from Browns Park to northern end of Ladore Canyon; lower Vermilion Creek, western Routt County; scattering fringe along White River from Utah boundary east to Angora; Plateau Creek, Mesa County; and Dolores River, at the mouth of West Creek (growing with *P. wislizeni*). This cottonwood occurs east of the mountains, as Rydberg records it from Fort Collins, Denver, and Walsenburg.

Salix amygdaloides. Peach-leaved Willow.

A common willow along streams in the Upper Sonoran zone on both sides of the mountains. Observed at Boulder; Livermore; on Green River near Ladore; and in the lower valleys of Snake and White Rivers.

Salix perrostrata.

Taken in June, 1905, in the foothills near Golden, where small clumps were growing in bogs on the higher slopes between 6,500 and 7,500 feet in the upper Transition zone.

Salix nuttalli. Nuttall Willow.

Scattered clumps were growing with *S. perrostrata*, between 6,500 and 7,500 feet, around springs and in bogs among the foothills near Golden. Willows noted in September, 1906, at springs on the northern slope of the Book Plateau, between 7,500 and 8,000 feet, were probably *S. nuttalli*.

Salix geyeriana.

Dense thickets of this low willow fringe most of the streams and bogs in Middle and Egeria Parks and near Hahns Peak. It was the prevailing species near Coulter in Middle Park and at the eastern end of the Elk Head Mountains near Columbine. It was not observed in the mountains of southern Colorado.

Salix glaucops.

This is perhaps the most abundant alpine willow in the mountains. (See fig. 35.) In June, 1905, I found dense copses on the higher slopes of Mount Kelso between 11,000 and 12,500 feet, and in 1906 it was common on the streams of Egeria Park and the Gore Range. The usual growth of this willow varies from about 4 feet in the lower part of its range in the Canadian zone to 2 feet or even less above timberline. The glabrous-leaved form (*S. g. glabrata*) is common in bogs on the alpine slopes of Mount Kelso.

Salix chlorophylla.

I have found this alpine willow only on Mount Kelso, where it grows on the boggy slopes between 11,000 and 12,500 feet in dense copses from 2 to 4 feet high. It was more abundant above than below timberline.

Betula fontinalis. Rocky Mountain Birch.

This handsome birch forms a conspicuous fringe along foothill streams throughout the State, and often extends out on the plains for some distance. It is usually associated with narrow-leaved cottonwoods and willows, and I have seen it only near stream banks. In July, 1907, I found several large clumps fully 20 feet in height on Dolores River near the mouth of West Creek, at 5,000 feet. The species occurs regularly up to 8,000 and occasionally to 9,000 feet through the entire width of the Transition zone. I did not observe it in the Canadian zone.

I found *B. fontinalis* common at the following localities: Streams of Routt County; North Park; Plateau Creek; Bailey; Lake George; St. Elmo; Frying Pan River, Basalt to Peachblow; head of Smith Fork, West Elk Mountains; Unaweep Canyon; Placerville; Durango; Rico; Mancos; Bayfield; and La Veta.

Betula glandulosa. Dwarf Birch.

The habitat of the dwarf birch is along the borders of cold bogs and streams in the higher mountains, between 9,000 and 11,000 feet, in the upper Canadian and lower Hudsonian zones. It has been found on practically all the higher mountain ranges of the State. The normal growth is from 3 to 5 feet high, but in the Hudsonian zone at about 11,000 feet the species is dwarfed, rarely exceeding 2 feet. It was particularly abundant in 1906 in the mountain meadows on the Park Range and on the mountains east of Laramie River, where a low, dense growth fringed most of the bogs between 9,000 and 10,000 feet. I saw it on Grand River, 5 miles east of Hot Sulphur; on the San Juan Mountains near Ophir, at 10,500 feet; and southeast of Lake City, 9,000 to 11,000 feet. The leaves were falling near Lake City, October 18, 1907.

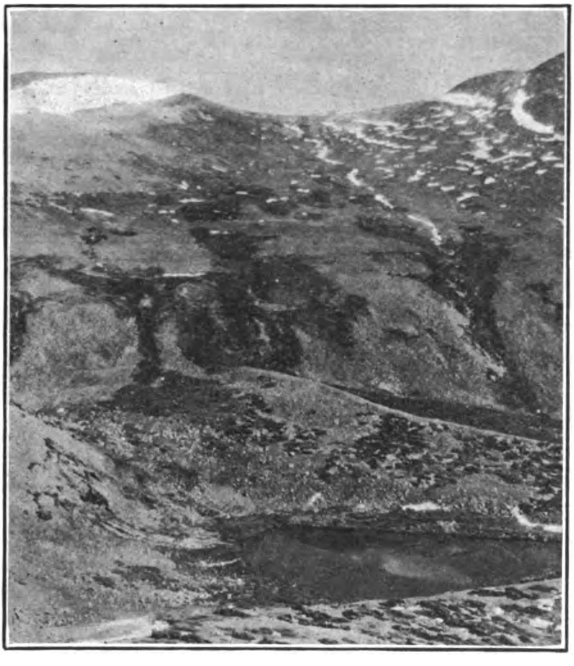

FIG. 35.—Alpine willows in Arctic-Alpine zone, Front Range, near Berthoud Pass.

Alnus tenuifolia. Alder.

Alders form a dense fringe along cold streams throughout the Colorado mountains. They are most abundant in the Canadian zone up to 10,000 feet, but occur regularly as low as 7,000 feet and occasionally to 6,000 feet. The species attains its maximum size along the smaller streams flowing from the Medicine Bow Mountains into North Park, a tributary of Canadian Creek being fringed with alders fully 20 feet in height.

The following localities at which I have noted alders indicate a wide and uniform distribution: Log Cabin, Larimer County; North Park; Hahns Peak; Snake River, Honnold to 10 miles above Slater; Gore Mountains; Fraser River, Middle Park; Smith Fork of Gunnison River, West Elk Mountains; Frying Pan River; Gunnison; Crested Butte; Pitkin; Sapinero, Lake Fork of Gunnison River; Wagon Wheel Gap; Poncha Pass; Creede; Manitou; Bailey, South Platte River; Lake George; Buena Vista; St. Elmo; Lone Cone; Unaweep Canyon; Rico; Silverton; Bayfield; Pagosa Springs; Pagosa Junction; La Veta; and Las Animas River, Segundo to Weston.

Corylus rostrata. Beaked Hazelnut.

Small thickets of hazel are common on Middle Boulder Creek, at Blanchard's ranch, 5 miles west of Boulder, at an elevation of nearly 6,000 feet. I did not observe the beaked hazel elsewhere in Colorado, but Rydberg records it from other points in the eastern foothills from North Cheyenne Canyon north to Larimer County.

Celtis reticulata. Hackberry.

The hackberry has a scattering distribution in the Upper Sonoran zone on both sides of the mountains, being most common on the eastern plains in gulches leading back from stream valleys. Small clumps are found in most of the canyons of the lowest eastern foothills from Boulder north to Fort Collins. I have not found it above 5,500 or 6,000 feet. Its growth in Colorado is uniformly scrubby, and only occasionally does it attain the stature of a tree. Hackberries are common on the bare foothill slopes near Platte Canyon Station, at Golden, Boulder, Arkins, and at a point 8 miles west of Fort Collins. Several large clumps grow in Shell Rock Canyon, northwestern Baca County. At Wray, Yuma County, the species is very common in the gulches leading back from Chief Creek Valley.

Few hackberries were met with in western Colorado. Scattering trees grow on the slopes along Plateau Creek, 5 miles east of Tunnel, Mesa County, and others on West Creek, near its junction with Dolores River, in southwestern Mesa County.

Atriplex canescens. Orache; Gray Saltbush.

This species has a wide range in the Upper Sonoran zone on both sides of the mountains, but is most abundant in western and southern Colorado. I have not observed it much above 7,000 feet. It is a characteristic shrub in the warmer valleys of the eastern foothills south of the Arkansas Valley, where it is locally termed "chico brush."

It often grows to a height of several feet on sandy or alkaline flats in the bottoms of valleys. Pocket gophers appear to feed extensively upon its leaves, which I have often found in their tunnels.

It was noted at the following localities: Lily Park; Midland Basin, Routt County; southwest of Rangely; Escalante Hills; desert north of Mack; Hotchkiss; Montrose; Paradox Valley; Dolores River, near mouth of West Creek; McElmo Valley; Medano Springs ranch, San Luis Valley; Salida; Gardner; La Veta; Limon; and 30 miles northwest of Sterling.

Atriplex confertifolia. Round-leaved Saltbush.

The round-leaved saltbush is a characteristic Upper Sonoran shrub of the desert stretches of western Colorado, growing principally upon dry alkaline flats, but often on sandy areas. Occasionally it forms a dense growth like sagebrush, as on the plains of extreme western Routt County, between the Escalante Hills and Vermilion Bluffs. (See Pl. III, fig. 2.) I observed the species at localities as follows: Lower Snake River Valley east to Baggs Crossing; plains north of Escalante Hills; Browns Park; Lily Park; Midland Basin; Maybell; badlands near Rangely; Evacuation Creek Valley; desert north of Mack; southern slopes of Book Cliffs to Atchee, 7,000 feet; Plateau Creek; Fruita; De Beque; Newcastle; Hotchkiss; Montrose; Paradox Valley; and McElmo Valley east to north base of Mesa Verde at Point Lookout. This species occurs also east of the mountains, as Rydberg records it from Denver and Pueblo.

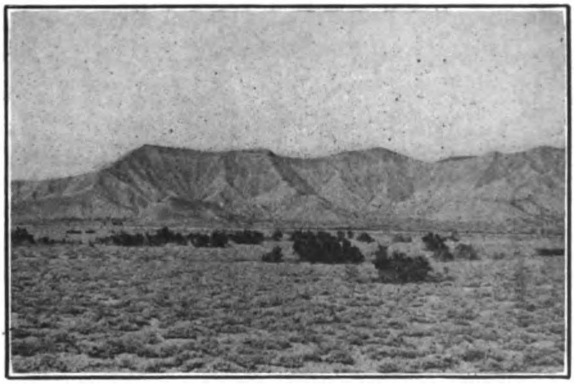

FIG. 36.—Desert vegetation (*Atriplex nuttalli* and *Sarcobatus vermiculatus*) in lower Grand River Valley, north of Mack, at 4,500 feet.

Atriplex nuttalli. Saltbush.

This small shrub, often called salt sage, is a characteristic Upper Sonoran species, found chiefly on alkaline flats in the desert valleys of western Colorado. In some of the dry desert basins it forms the principal shrubby vegetation, although it is of small size and usually more or less prostrate. It is the most conspicuous shrub in Midland Basin, western Routt County; on the desert north of Mack (see fig. 36); and on the alkaline stretch of country between Hotchkiss and the West Elk Mountains. I found it abundant in Browns Park;

along Snake River west of Baggs Crossing; southwest of Rangely; and in McElmo and Uncompahgre Valleys.

Grayia spinosa. Common Grayia.

This low, spiny, mealy shrub is a characteristic plant in the sandy and alkaline Upper Sonoran tracts of northwestern Colorado, where it grows in profusion in river valleys and on the lowest bordering benches up to a little over 6,000 feet. Together with *Atriplex confertifolia,* it forms the principal shrubby growth in some of the river valleys of western Routt and Rio Blanco Counties (see Pl. III, fig. 2). I found it common in the Snake River Valley from 20 miles west of Baggs Crossing to Lily; on the flats between the Escalante Hills and Browns Park; in Midland Basin; in White River Valley from Angora westward to the Utah boundary; on rocky slopes along Bear River at Maybell; on the desert north of Mack, Mesa County; at Rifle, Hotchkiss, and Somerset. In the Browns Park region the leaves had nearly all fallen by the 1st of September.

Grayia brandegei.

The shrubby growth observed on the tops of low mesas along the McElmo Valley near Moqui was probably *G. brandegei*, recorded by Rydberg from the McElmo Valley.

Sarcobatus vermiculatus. Greasewood.

The zonal range of the greasewood is mainly Upper Sonoran. Its wide range over the lower parts of the State is well indicated by the following localities at which it was observed during my explorations: North Park in alkaline situations; Snake River Valley to 5 miles east of Slater at 6,800 feet; Bear River Valley east to Craig and Steamboat Springs; Browns Park (very rank growth, sometimes 12 feet in height); Lily Park; Midland Basin; Rangely; Texas Creek; Evacuation Creek; north of Atchee, southern slope Book Plateau, to 7,500 feet; desert north of Mack (see fig. 36); Plateau Creek; De Beque; Rifle; Dotsero to Eagle; Kremmling and Muddy Creek Valley, Middle Park; Hotchkiss; Montrose region; Dallas Creek near Ridgway; lower valleys of San Miguel and Dolores Rivers; McElmo Valley; Montezuma Valley east to north base of Mesa Verde at Point Lookout; Bayfield; Salida; Gardner; San Luis Valley generally—Alamosa, Saguache, Hooper, Villa Grove, Mosca, and Medano ranch.

Berberis fendleri. Barberry.

In Colorado the barberry appears to be confined to dry rocky slopes and ridges in the region south and west of the San Juan and La Plata Mountains. I found a scattering growth on rocky ridges in the yellow pine forest at Pagosa Springs (7,000 feet), and later met with the species on dry, open slopes at Durango. Rydberg records *B. fendleri* from Durango, Arboles, Mancos, and Mancos Canyon.

Odostemon aquifolium. Oregon Grape.

The Oregon grape has a wide distribution in the Colorado mountains from the foothills to about 10,000 feet. I found it most abundant on cool, shaded slopes in the upper part of the yellow pine belt, where with *Arctostaphylos* it forms the characteristic lower undergrowth. The ripe clusters of bluish berries remain on the shrubs for some time in the autumn. The Oregon grape is abundant at Boulder; Coulter, Middle Park; Floyd Hill; Honnold; northern slopes of Elk Head Mountains; northern slopes and summit of Escalante Hills, 7,000 feet; canyon of the Grand above Glenwood Springs; Unaweep Canyon; Cerro Ridge; Somerset; West Elk Mountains, head of Smith Fork; Sapinero; Dolores; Mesa Verde; Bayfield; Pagosa Springs; Wet Mountains east of Westcliffe; and hills near La Veta.

Odostemon fremonti.

In August, 1907, I found this large prickly-leaved shrub abundant along the Smith Fork of Gunnison River, at the western base of West Elk Mountains, a few miles east of Crawford, Delta County. At this point it was growing among junipers and pinyons on the warm rocky slopes near the stream. Many of the shrubs were 6 or 8 feet in height. Rydberg records *O. fremonti* from Smith Fork Canyon, and it is not known to occur elsewhere in the State.

Edwinia americana.

I have not observed this species west of the Continental Divide, but it is a conspicuous shrub on cliffs and rock ledges on the eastern slope across the State from north to south, chiefly in the Transition zone. It was in full bloom in the foothills west of Boulder June 10, 1905, and the white-flowered cymes were very handsome. It is particularly common in the hills along the South Platte near Bailey, and between Manitou and Woodland Park.

Fendlera rupicola.

In Colorado this low shrub is confined to the southwestern counties, where it is tolerably common on dry slopes and low mesas in the Upper Sonoran and lower Transition zones. It was abundant on the pinyon slopes along the Los Pinos at Bayfield, La Plata County (6,500 feet), and a few of the shrubs were in flower June 5, 1907. It was common in July, 1907, on the low benches along Dolores River between Salt Canyon and the mouth of West Creek, at 5,500 feet, and I noted it for some distance up the valley of West Creek. Rydberg records the species from Durango, Mancos, Cerro Summit, Dolores, Hotchkiss, and Los Pinos.

Ribes cereum. Red Currant.

This is a common currant on dry rocky slopes up to at least 10,000 feet, but is most abundant in the yellow pine belt. Observed at

Boulder; Golden; Pawnee Buttes, northeastern Weld County; Bailey; Manitou; Buena Vista; Como; St. Elmo; Thomasville; Wagon Wheel Gap; Coulter; Escalante Hills; and Pagosa Junction.

Ribes wolfi.

This high-ranging currant is not uncommon in the Canadian and Hudsonian zones, growing even on rocky slopes to a short distance above timberline. It was not observed at any point below 8,000 feet. The black viscid berries were still on the bushes on the summit of the Book Plateau September 22, 1906. It is a common shrub on Lone Cone, San Miguel Mountains; at Thomasville; and on McClellan Mountain between 11,000 and 12,000 feet.

Ribes longiflorum. Golden Currant.

The zonal range of this flowering currant is mainly Upper Sonoran. Its yellow bloom was conspicuous at Boulder June 8, 1905, and along the San Juan River at Pagosa Springs May 27, 1907. This currant was observed also at Golden and at Wray. Vernon Bailey reports it common along streams in the southern end of San Luis Valley.

Opulaster intermedius. Nine bark.

In early June, 1905, I found this handsome flowering shrub in full bloom on Middle Boulder Creek at 5,800 feet, in the Transition zone. Rydberg records it from other points in the eastern foothills of the Front Range.

Opulaster monogynus.

Common in June, 1905, in the foothills near Boulder and Golden between 6,500 and 7,500 feet. This species does not grow along streams like *O. intermedius*, but on dry rocky slopes. Rydberg gives *O. monogynus* a wide distribution in the eastern and central mountain districts.

Rubacer parviflorus. Salmonberry.

The large-leaved salmonberry is conspicuous on cool forested slopes in the Canadian zone throughout the mountains of western and central Colorado, but is uncommon east of the Continental Divide. The large juicy red fruit has a delicious flavor and is usually ripe by the end of August. Salmonberries were found in great abundance on the western slopes of the Park Range east of Steamboat Springs; near Hahns Peak, 8,000 to 8,500 feet; on the Book Plateau; on Lone Cone; and at Thomasville.

Oreobatus deliciosus. False Raspberry.

This is a characteristic shrub in the eastern foothills up to 9,000 or 10,000 feet, but was not observed in the western mountains. In the foothills west of Boulder the large showy white flowers were out June 6, 1905, and the species was flowering at Georgetown June 20. It is particularly abundant in the yellow pine belt at Bailey and on the slopes near Buena Vista. The dark purplish fruit of this shrub is inedible.

Rubus strigosus. Red Raspberry.

Red raspberries were fully ripe on cool north slopes in the yellow pine belt near Arkins July 26, 1906. At this locality they were growing in profusion at 6,000 feet. The species is common at Ophir, St. Elmo, Thomasville, and on the eastern slopes of the Sangre de Cristo Range in western Huerfano County. It is usually found in slide rock or in areas which have been swept by forest fires.

Dasiphora fruticosa. Shrubby Cinquefoil.

The shrubby cinquefoil is one of the most showy flowering shrubs in mountain meadows and on open slopes between 8,000 and 11,000 feet. It occurs in greatest abundance in wet meadows in the high mountain parks at 9,000 or 10,000 feet in the Canadian zone. The large yellow flowers dotted the upper slopes of Mount McClellan between 10,500 and 11,000 feet during the middle of June, 1905, and the species was flowering at 10,000 feet on the South Park plains at Como as late as August 21, 1907. Above 11,000 feet *Dasiphora* occurs in a dwarfed state not over a foot high—about half its normal growth. It is an abundant shrub near Pearl, in northwestern North Park, at 8,700 feet, where it was flowering August 8, 1906. I observed the species on the White River and Uncompahgre Plateaus; at Divide, Teller County; in Slate River Valley between Almont and Crested Butte; and in the meadows along the headwaters of Cebolla Creek, southeast of Lake City, up to 11,000 feet.

Holodiscus dumosus.

This handsome flowering shrub is conspicuous among rocks in the foothill districts up to 9,000 feet on both slopes of the mountains. The species occurs mainly in the Transition zone. It was in flower July 12, 1905, in the canyon along Grand River just west of Hot Sulphur. I have found it common in the canyon of the Grand above Glenwood Springs; in Unaweep Canyon; on the Uncompahgre Plateau, head of Dominguez Creek; at Ouray; Buena Vista; and in the Wet Mountains east of Westcliffe, 9,500 feet.

Kunzia tridentata.

This species is generally distributed over the mountainous sections of the State from 6,000 to 9,500 feet. It is usually present on dry open hills and was not observed in heavy forests. It forms dense thickets in the sand dunes along the western base of the Medicine Bow Range in North Park, and in the sandy yellow pine country on the head of Dominguez Creek, at the northern end of Uncompahgre Plateau. At a little distance this species bears a close resemblance to sagebrush (*Artemisia tridentata*), but is darker green and seldom grows to a height of more than 2 feet. It is usually in full bloom by the 1st of July.

K. tridentata was observed at the following localities: Nederland; Elkhorn, Larimer County; bare hillsides along Snake River at Slater; Canadian Creek, North Park; Coulter, Middle Park; river bluffs near Baggs Crossing; watershed between Snake and Bear Rivers; O-wi-yu-kuts Plateau; Escalante Hills; Book Plateau (a little on 8,500 foot summit at Columbine); canyon of the Grand above Glenwood Springs; Somerset; Dillon; Sapinero; Arboles; East Paradox Valley (rare); and Uncompahgre Plateau.

Cowania mexicana. Cliff Rose.

The handsome cliff rose is restricted in Colorado to the warm valleys and lower mesas of the southwestern counties, where it has an irregular distribution from the Mesa Verde north to Unaweep Canyon. The growth is usually from 4 to 6 feet. The species forms the most conspicuous shrubbery on the warm open rocky slopes along the north side of Unaweep Canyon, at the northern end of the Uncompahgre Plateau, where it occurs up to 7,000 feet. By the end of July, 1907, it had ceased blooming in Unaweep Canyon and also on the lower slopes of Salt Canyon, between Sinbad Valley and Dolores River, at 5,500 feet. Cliff roses were a mass of yellow bloom June 13, 1907, along the rocky rims of Navajo Canyon, Mesa Verde, at 7,000 feet. Here they were growing commonly among junipers and pinyons, often on rocks where there was scarcely any soil.

Cercocarpus parvifolius. Mountain Holly.

The mountain holly is almost omnipresent on the warmer foothill slopes from the lowest edge of the pinyon belt to the upper edge of the yellow pine belt, on both slopes of the mountains. It forms a dense growth, covering many of the open slopes along the lowest edge of the foothills, and it is common on the higher rocky ridges on the plains of northeastern Colorado at a little over 5,000 feet.

The following localities show the wide range of *C. parvifolius:* Livermore; Pawnee Buttes, Weld County; Platte Canyon Station; Bailey; Salida; Golden; Boulder; Manitou; Eastonville; Walsenburg; Gardner; Trinidad; Slater; Godiva Ridge; Escalante Hills; O-wi-yu-kuts Plateau; south of Lily; southwest of Rangely; Plateau Creek; De Beque; Meeker; West Elk Mountains east of Crawford; Somerset; Cerro Summit; Ouray; Placerville; Naturita; Sinbad Valley, above 6,000 feet; Dolores; Ute Peak, lower slopes; Mancos; Mesa Verde; Arboles; Bayfield; and Wagon Wheel Gap.

Cercocarpus ledifolius. Mountain Mahogany.

The mountain mahogany was noted on the 7,000-foot crest of the Escalante Hills near Douglas Spring, in western Routt County, where

I found it growing commonly on rocky ridges among the yellow pines in September, 1906. Apparently it does not occur elsewhere in Colorado.

Rosa manca. Rose.

This handsome rose grows in profusion in openings along the crest of the Uncompahgre Plateau at about 9,000 feet. The bushes were a mass of pink bloom near Uncompahgre Butte July 16, 1907.

A great variety of wild roses grow in the Colorado mountains up to 10,000 feet, and are in flower nearly all summer. Since few specimens were collected, I am unable to correlate my notes with the various species and can give no data of consequence on their distribution.

Amelanchier bakeri. June Berry.

This June berry was collected on West Creek, near its junction with Dolores River, in western Mesa County. It is a common shrub in the Unaweep Canyon and also on the summit and upper slopes of Mesa Verde, where it forms a dense chaparral. This is probably the species so abundant over most of the mesas from western Montezuma County north to Mesa County, in the Transition zone.

Amelanchier oreophila.

An *Amelanchier* which I collected on Lone Mesa, Dolores County, in June, 1907, proves to belong to this species. Scattering shrubs of small size were growing among the oak chaparral on the dry upper slopes at 9,400 feet, in the lower Canadian zone. I did not collect it elsewhere, but Rydberg gives it a wide range on the western slope.

Amelanchier alnifolia. Common June Berry.

As few specimens of June berries were preserved, the distribution data given below doubtless refers to several species. *A. alnifolia* is, however, the widest ranging species in the State. June berries are abundant on the dry, partially open Transition slopes throughout the mountains, and on many of the western mesas they often form a dense chaparral. Some years they bear an abundance of fruit, but usually it is rather scanty and of poor quality. The berries are eagerly eaten by birds and chipmunks. I observed the shrubs in abundance at the following localities: Hahns Peak, below 8,500 feet; slopes along Snake River between Honnold and Baggs Crossing; Godiva Ridge; O-wi-yu-kuts Plateau; Escalante Hills, above 6,400 feet; south of Lily; southwest of Rangely; Book Plateau, everywhere above 6,500 feet; Plateau Creek; south of De Beque; canyon of the Grand above Glenwood Springs; bluffs between Dotsero and Wolcott; summit of Piney Divide, 8,500 feet; Transition slopes bordering Sinbad Valley; Lone Cone; Dolores; Mancos; Durango; Bayfield; Pagosa Springs; Pagosa Junction; and La Veta.

Peraphyllum ramosissimum. Dwarf Apple.

I found this shrub in great abundance on dry open hillsides south and west of the San Juan and La Plata Mountains, chiefly between 6,500 and 7,500 feet. The dry slopes along the Los Pinos at Bayfield were covered with a mass of its pale roseate blossoms the first week in June, 1907, and it was in flower up to the middle of the month on the Mesa Verde. It was noted as follows: South slope of Book Plateau above Atchee, 8,000 feet; Newcastle; East Fork of Rifle Creek; canyon of the Grand above Glenwood Springs; Basalt; Somerset; rocky slopes near Hotchkiss; Montrose region above 7,000 feet; north base of Lone Cone at 7,000 feet; Sinbad Valley rim above 6,000 feet; Dolores; McElmo Valley; Arboles; and Bayfield.

Prunus americana. Wild Plum.

This species occurs sparingly in gulches on the eastern plains and at the eastern base of the foothills in the Upper Sonoran zone. Thickets of wild plum were observed at Wray; Gaume's ranch, northwestern Baca County; Arkins; and Boulder. Rydberg records the species from a number of localities extending across the State from north to south at the base of the foothills.

Prunus pennsylvanica. Red Cherry.

Rydberg gives the red cherry a wide range in the eastern foothills of the Front Range up to 9,500 feet. I found it common in the foothills at Boulder and Manitou.

Prunus melanocarpa. Chokecherry.

This species appears from my observations to be the common wild cherry of the mountains, particularly in western Colorado. The growth is uniformly scrubby, often forming a dense chaparral on the Transition zone summits and upper slopes of plateaus and mesas in the western counties. It is sparingly present in gulches on the eastern plains. The following are localities at which *P. melanocarpa* was observed: Northern slopes Elk Head Mountains, 7,800 feet; Slater to Baggs Crossing; White River below Angora; Book Plateau, dense chaparral 7,000 feet to summit; Glenwood Springs; summit of Piney Divide, 8,000 feet; Pitkin; Somerset; lower slopes of Lone Cone; Uncompahgre Plateau; Placerville; Ouray; Vernal Mesa; West Elk Mountains east of Crawford; Frying Pan River, Basalt to Thomasville; Dolores; Mancos; Hermosa; Arboles; Pagosa Springs; Sterling; Wray; and Tuttle.

Robinia neomexicana. Locust.

A very few of these locusts were observed on the rocky banks of Grand River near Tunnel, Mesa County, at about 5,000 feet. Recorded by Rydberg from Denver, Walsenburg, La Veta, and Trinidad.

Rhus rydbergi. Poison Ivy.

The poison ivy is common in canyons on the eastern plains and also in the lower eastern foothills of the Front Range. It was observed at Tuttle; Wray; Pawnee Buttes; in gulches along the southern escarpment of the Chimney Cliffs, 30 miles northwest of Sterling; in the foothills at Boulder and Golden; and it was collected in Navajo Canyon, Mesa Verde, southwest Colorado.

Schmaltzia glabra. Sumac.

This sumac I have found sparingly up to 6,000 feet in the foothills west of Boulder and Golden, and also near Livermore and Platte Canyon Station. Its brilliant reddish autumnal foliage was very conspicuous on the slopes along Middle Boulder Creek October 20, 1906, when the leaves had just commenced to fall.

Schmaltzia trilobata. Skunk Bush.

The zonal range of this sumac is mainly Upper Sonoran, and it is equally abundant on both sides of the mountains. In the foothills it usually grows on the warm sides of canyons and along streams. In the warm desert valleys of western Colorado it is often found with sagebrush in the open, but also forms a good growth along watercourses, where it sometimes attains a height of 8 or 10 feet. East of the mountains this sumac occurs chiefly in gulches in the rougher parts of the plains.

S. trilobata was observed as follows: Tuttle; Wray; bluffs east of Sterling; Chimney Cliffs; Pawnee Buttes; Gaume's ranch, northwestern Baca County; Livermore, dry slopes up to 6,500 feet; Boulder; Golden; Platte Canyon Station; Segundo; Buena Vista, up to 8,500 feet; bluffs along Snake River below Baggs Crossing; Plateau Creek; Basalt; Hotchkiss; Naturita; Sinbad Valley; West Creek; McElmo; and Pagosa Springs.

Pachystima myrsinites.

This little evergreen shrub is abundant throughout the mountains, growing in dense clumps in wooded gulches and on shaded north slopes between 6,000 and 9,000 feet. It was found in abundance at the following localities: Northern slopes of Elk Head Mountains at 7,800 feet; Park Range up to 9,000 feet; canyon of the Grand above Glenwood Springs; summit of Escalante Hills; Book Plateau, 8,000 feet; Navajo Canyon, 7,000 feet; and northern escarpment of Mesa Verde.

Acer glabrum. Mountain Maple.

The mountain maple is common and widely distributed in the mountains of Colorado, growing in greatest profusion on damp shaded slopes between 5,500 and 9,000 feet and forming dense clumps on the borders of streams and bogs. The bright yellow autumnal foliage gives a brilliant coloring to the mountain slopes in late September. The average height is not over 8 feet, although 12 feet is sometimes attained. I have found this species especially common among the eastern gulches of the Front Range and on both slopes of the Saguache Range. It occurs on the northern slope of the Book Cliffs and is abundant at Aspen and in most of the mountains of southern Colorado.

Acer negundo. Box Elder.

Box elders are common trees on most of the streams of the eastern plains and scattered clumps are often met with on foothill streams to elevations of 7,000 or 8,000 feet on both sides of the mountains. The zonal distribution is mainly Upper Sonoran. In my trips over the State I have found box elders at the following localities: Snake River, from 5 miles east of Slater to Baggs Crossing; southern slopes of Book Cliffs near Atchee at 7,500 feet; Rifle Creek; canyon of Plateau Creek; canyon of the Grand above Glenwood Springs; Frying Pan River, Basalt to Peachblow; Ouray; Unaweep Canyon; Wray; Platte Canyon Station; Las Animas River, Segundo to Weston; and Shell Rock Canyon, northwestern Baca County.

Rhamnus smithi. Buckthorn.

This species is known apparently from only two localities in the State. It was abundant and in flower May 27 on the banks of San Juan River at Pagosa Springs (7,000 feet), and was again encountered in the hot canyon of Dolores River between Salt Canyon and the mouth of West Creek at about 5,000 feet. Dense spreading thickets of buckthorn, often 10 or 12 feet high, fringed Dolores River for most of this distance and extended eastward in the West Creek Valley to an elevation of 5,500 feet. The black-green foliage of *R. smithi* was in marked contrast to the predominant gray-green desert vegetation along the Dolores and on the bordering canyon sides. The fruit of this shrub had nearly all turned to a rich purplish black, July 13, 1907, but some was still green or only partially colored. This species has been recorded from Pagosa Springs by Rydberg.

Ceanothus velutinus. Mountain Balm.

This shrub forms a dense chaparral about 2 feet in height on the central slopes of most of the mountain ranges of northern Colorado, extending south to Thomasville on the western slope of the Saguache Range. I did not see it on any of the mountains of southern Colorado. The rankest growth was observed in the Middle Park region, on the Park Range, and on the hills around Steamboat Springs, where in places the dense thickets were well-nigh impassable. The species is occasionally found as low as 6,500 feet, but usually grows between

7,500 and 9,500 feet. It is most abundant on dry, partially open slopes which have been burned over by forest fires. The oval bright green leaves are remarkably shiny and glabrous, giving a peculiar brilliance to this chaparral on a bright day.

Other points where I observed *C. velutinus* are: Northern slopes of Elk Head Mountains; bluffs along Snake River, 10 miles east of Slater; Escalante Hills, 7,000 feet; watershed between Bear and White Rivers, north of Midland Basin, 6,500 feet; juniper slopes at McCoy, 7,000 feet; northern slopes of Piney Divide, 8,000 feet; Coulter, Middle Park; northern slopes of Book Plateau; and Dillon.

Ceanothus pubescens.

This is a common shrub on dry rocky slopes in the eastern foothills of the front ranges, chiefly in the Transition zone. I found it abundant also in sandy yellow pine forest near the head of Dominguez Creek on the Uncompahgre Plateau, at 8,000 feet. It is common in the foothills near Boulder and La Veta.

Ceanothus fendleri.

This species is common in the Transition zone over most of the State, according to the range given by Rydberg. I have met with it only in the southwest on the summit of Lone Mesa, 9,400 feet, and on the open gravelly benches along McElmo Creek in western Montezuma County, 5,500 feet.

Cactus missouriensis. Ball Cactus.

The common ball cactus is abundant on the high plains from the Arkansas Divide near Cheyenne Wells northwest to Weld and Logan Counties. I have found it common on the South Park plains near Como up to 10,000 feet, in the yellow pine belt at Bailey, and on the sage plains of western Routt County.

Cactus radiosus.

This ball cactus is tolerably common among rocks in the pinyon belt at Coventry, in western Montrose County, where I collected specimens in July, 1907, at an elevation of 6,500 feet.

Echinocactus simpsoni. Snake Cactus.

This peculiar cactus is found chiefly at the higher elevations. In November, 1907, I found it common in Wet Mountain Valley; in the Wet Mountains east of Westcliffe between 9,000 and 9,500 feet; and on the eastern slopes of the Sangre de Cristo Range near Mosca Pass—both in yellow pine forest and in the open.

Echinocereus viridiflorus. Cereus.

This greenish flowered cereus is abundant in the eastern foothills of the front ranges across the State from north to south. It ascends to at least 9,000 feet in the Wet Mountains east of Westcliffe, where in November, 1907, I found it in rocky soil among the yellow pines. It was common at Walsenburg, 7,000 feet; and at Gaume's ranch, in Shell Rock Canyon, northwestern Baca County, it was abundant among rocks at 4,600 feet. The species was not observed in western Colorado.

Echinocereus paucispinus.

This cereus is not uncommon in the rocky pinyon and juniper country of southwestern Colorado, chiefly below 7,500 feet. It was taken north of Dolores at 7,500 feet, and was very common at Coventry. It is recorded from Durango by Rydberg.

Opuntia polyacantha. Prickly Pear.

This is an Upper Sonoran species, occasionally growing to 7,000 feet on warm slopes in the foothill valleys. It is of general occurrence on the plains east of the mountains, where it is the common prickly pear, and it is present on the sage plains of Routt County. The yellow flowers usually dot the plains during the first two weeks in June. It is common at Slater; Snake River Valley; Maybell; Boulder; Fort Collins; Sterling; Pawnee Buttes; Platte Canyon Station; Limon; Wray; Cheyenne Wells; Pueblo; Walsenburg; Salida; and Gaume's ranch, northwestern Baca County.

Opuntia rhodantha.

This handsome red-flowered prickly pear is abundant in the warm valleys of extreme southwestern Colorado. At McElmo it was in bloom during the middle of June, 1907. Rydberg records it from Grand Junction and Boulder.

Opuntia camanchica.

A large-jointed species, chiefly of southwestern Colorado—McElmo, Cortez, Dolores, Coventry, and Paradox Valley. It was in flower in McElmo Valley June 15 to 22, 1907. Rydberg records it from Colorado Springs.

Opuntia fragilis.

This small-jointed species is not uncommon in the foothill districts between 6,000 and 8,500 feet, in the Transition zone. It was growing in rocky situations in the yellow pine forest near Pagosa Springs, and also on the northern end of the Uncompahgre Plateau, and was occasionally noted on the high plains near Pawnee Buttes, in northeastern Weld County. It was observed on rocky juniper slopes along the head of Smith Fork, West Elk Mountains; at Somerset; Buena Vista; Plateau Creek, Mesa County; and Unaweep Canyon. Rydberg records it from Denver and Boulder.

Opuntia arborescens. Tree Cactus.

The tree cactus is a characteristic Upper Sonoran species from the Arkansas Valley southward (see fig. 37), and over much of southeastern Colorado is the most prominent shrub on the level plains. It extends some distance into the foothills along the warmest slopes of the valleys, reaching its western limit in the Arkansas Valley at a point 5 miles east of Salida, and in the Huerfano Valley a short distance above Gardner. It reaches at Fountain its northern limit along Fountain Creek, and it occurs near Trinidad in the Las Animas Valley, and at Walsenburg in the Cucharas Valley. It is particularly abundant in the canyons of Las Animas and western Baca Counties.

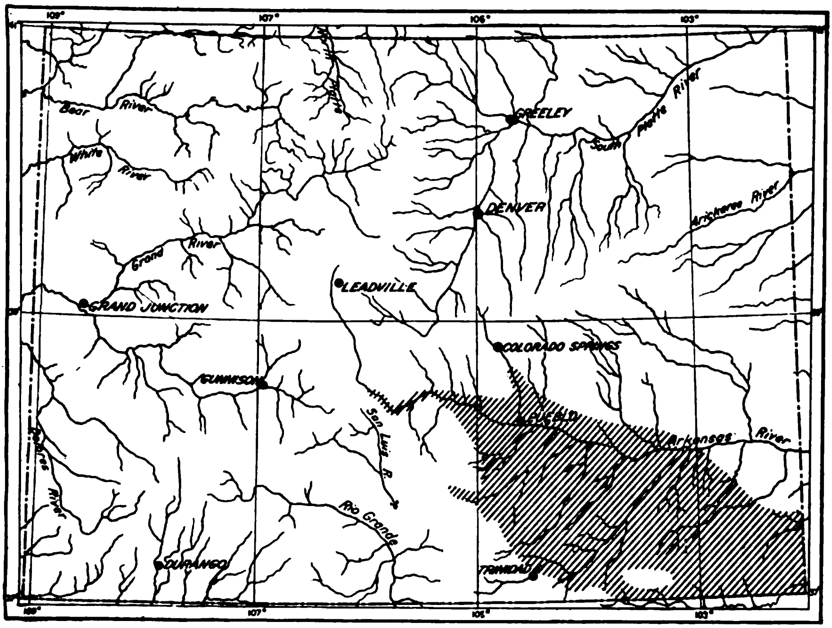

FIG. 37.—Distribution in Colorado of tree cactus (*Opuntia arborescens*).

Lepargyrea argentea. Buffalo Berry.

Dense thickets of buffalo berry are present along many of the streams of the plains on both sides of the Continental Divide, and the species extends into the foothills along some of the watercourses to an elevation of from 6,000 to 7,000 feet. The zonal distribution is mainly Upper Sonoran. Sandy river banks are especially suited to the growth of the buffalo berry. The brilliant scarlet clusters of berries are usually ripe by the middle or end of August, and are eagerly eaten by sage thrashers and many other birds. In late August, 1907, chipmunks (*Eutamias minimus*) were feeding extensively upon the ripe buffalo berries in the Snake River Valley. We found the berries when cooked and used as sauce a welcome addition to our camp fare, but uncooked they are extremely acid. Observed at La Porte; Snake River Valley, Slater to Lily; Browns Park; White River Valley, Angora to Rangely; Dotsero to Eagle; Newcastle; Dallas Creek, near Ridgway; Basalt; Hotchkiss; near Montrose; Naturita; Pagosa Junction; Arboles; and along most of the streams on the eastern plains.

Lepargyrea canadensis. Canadian Buffalo Berry.

This is a characteristic Canadian zone shrub in the mountains of northern and central Colorado, becoming less common toward the south. It is conspicuous in the undergrowth of the dry lodgepole pine forests of the central mountain slopes between 8,000 and 10,000 feet, but I have not observed it much lower. Above 10,000 feet it becomes decumbent, often not more than a foot high, and is of rare occurrence above 11,000 feet. The bright red berries of this buffalo berry have an attractive appearance, but are unpalatable and very bitter. They are ripe by the 1st of August, and usually remain on the bushes during most of that month. The leathery leaves had nearly all fallen at St. Elmo, in the Saguache Range, at 10,000 feet, October 9, 1907.

I found *L. canadensis* at the following localities: Eight thousand five hundred to ten thousand feet on the Medicine Bow and Laramie Mountains; Park Range, west of Pearl, 9,000 to 10,000 feet; Ophir, to 10,500 feet; Culebra Range, near La Veta; Thomasville; Floyd Hill; Como; Dillon; and St. Elmo. Rydberg mentions its occurrence in the southwestern mountains—near Ouray and on Bear Creek Divide in the West La Plata Mountains.

Svida stolonifera riparia. Red-osier Dogwood.

The dogwood or cornel is a prominent shrub along streams in the Transition zone nearly throughout the mountains, and its clusters of white berries are very conspicuous in autumn. Rydberg records another species (*S. interior*) from several points in the foothills, but in my trips through the mountains I have met with only the present species. I observed the cornel on Plateau Creek, east of Tunnel; along White River at Meeker; on the upper reaches of Smith Fork, in the West Elk Mountains; along streams heading in Book Cliffs, above 7,500 feet; and on most of the streams on the eastern slopes of the Front Range.

Arctostaphylos uvaursi. Red Bearberry.

This handsome bearberry is one of the most widely distributed mountain shrubs in Colorado, growing on practically all the ranges from 6,000 to 10,000 feet. It grows luxuriantly on dry shaded slopes beneath lodgepole and yellow pine forest, and the trailing mats of rich dark green are usually very dense and of considerable extent.

I found the red bearberry abundant at Thomasville; Dillon; Como; St. Elmo; Escalante Hills, summit at 7,000 feet; Wet Mountains, east of Westcliffe; Bradford, Huerfano County; foothills west of Boulder; Coulter, Middle Park; Divide; and in the yellow pine forest on the Arkansas Divide at Eastonville.

Arctostaphylos pungens platyphylla. Manzanita.

The manzanita is found on the dry slopes of the Uncompahgre Plateau and on the eastern slopes of the La Sal Mountains in western Montrose County. It appears not to have been recorded previously from the State.

In July, 1907, I noted a scattering growth on the head of Dominguez Creek, at the northern end of the Uncompahgre Plateau, and in descending the steep southwestern escarpment north of Tabeguache Creek a dense chaparral of this manzanita was traversed on the rocky slopes immediately below the aspen belt, at about 8,000 feet. I found it a common undershrub in the yellow pine forest just above the western rim of West Paradox Valley, between 7,000 and 8,000 feet. The species came under my observation only in the Transition zone and appears to grow principally on dry, partially open slopes.

Vaccinium cæspitosum. Huckleberry; Blueberry.

This blueberry is common from Yankee Doodle Lake (10,500 feet) to timberline on Rollins Pass; at Ophir (10,500 feet) to timberline; and on the upper slopes of Lone Cone. It is most abundant on the mossy floor of the Canadian zone forests.

Vaccinium oreophilum. Bilberry.

The bilberry forms low, dense carpets 8 or 10 inches high in the lodgepole pine and Engelmann spruce forests between 8,000 and 11,000 feet, and is particularly abundant on the Front, Park, and Gore Ranges. (See fig. 38.) I found it on Mount McClellan and near Berthoud Pass at 11,000 feet altitude.

Vaccinium erythrococcum. Small-leaved Bilberry.

This diminutive small-leaved bilberry occurs on Mount McClellan between 11,000 feet and timberline, and was observed on Berthoud Pass, Buffalo Pass, and on the Park Range along the headwaters of Grand Encampment River. Rydberg records it from a number of localities on the Front, Saguache, Park, and Sangre de Cristo Ranges.

Fraxinus anomala. Ash.

This small Sonoran species I saw only in the warmer parts of southwestern Colorado, where it was observed at several localities from Mesa County south to Montezuma County at elevations varying from 5,000 to 5,500 feet. It usually grows to a height of from 6 to 10 feet, and single trees or small clumps are scattered here and there in gulches and on the warm rocky slopes in canyons. It was observed in the following places: Slopes bordering McElmo Valley, between Moqui and McElmo; Salt Canyon, the outlet of Sinbad Valley; canyon of Dolores River down to the mouth of West Creek; western (lower) part of Unaweep Canyon; and lower slopes bordering West Paradox Valley. Rydberg records this species from Grand Junction, Deer River, and between Hotchkiss and Smith Fork.

Lycium pallidum. Matrimony Vine.

This species is restricted in Colorado, so far as known, to the low arid Upper Sonoran stretches of the extreme southwest. I found a scattering growth in the partially open sage and pinyon country between Bayfield and Ignacio, La Plata County. It is recorded by Rydberg from McElmo Creek and San Juan Valley.

Sambucus microbotrys. Elder.

This elderberry is abundant in the Canadian zone forest throughout the mountains between 8,000 and 10,500 feet. I have seldom observed it in the Transition zone, but occasionally it occurs nearly to timberline. The red berries are usually ripe by the middle of August or the first of September. *S. microbotrys* is abundant on both slopes of the Front Range; at Pearl, North Park; Buffalo Pass, Park Range; summit of Continental Divide; north of Hahns Peak; Arapahoe Pass, Rabbit Ear Mountains; Thomasville; Dillon; St. Elmo; headwaters of Cebolla Creek southeast of Lake City; and Lone Cone.

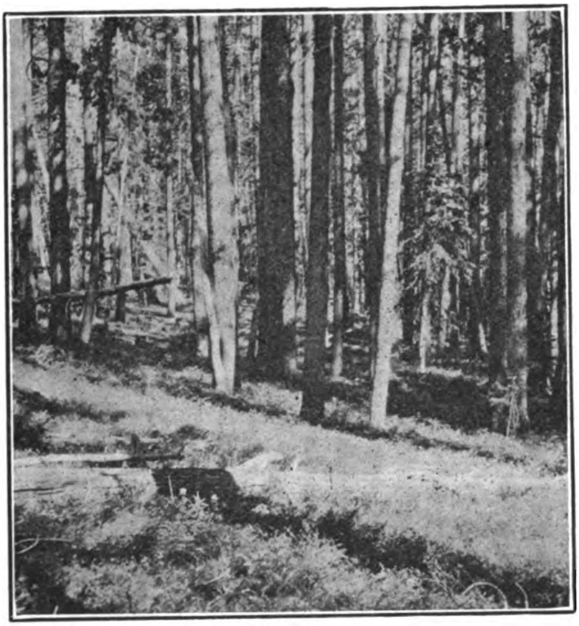

FIG. 38.—*Vaccinium oreophilum* on the floor of lodgepole pine forest, Park Range, west of North Park, 10,000 feet.

Sambucus melanocarpa.

This is a lower ranging species than *S. microbotrys*, and grows more in the open and chiefly in the Transition zone. I met with it only in western Colorado, but Rydberg records it from several points in the eastern foothills of the Front Range. It was noted as follows: Western slope of Continental Divide north of Hahns Peak, 9,000 feet; Hahns Peak; Escalante Hills, 6,400 to 7,000 feet; and Uncompahgre Plateau, 8,000 feet. It was growing in profusion on the rocky northern slopes and along the crest of the Escalante Hills, where the black berries were fully ripe September 3, 1906.

Viburnum pauciflorum. Few-flowered Viburnum.

This small viburnum was observed only at Arapahoe Pass, Rabbit Ear Mountains, at an elevation of 9,000 feet. Rydberg records it from Grand Lake, Minnehaha, and Clear Creek.

Linnæa americana. Twinflower.

The twinflower occurs on the higher slopes of the front ranges nearly across the State, according to Rydberg. I collected it at 10,000 feet near Idlewild on the Middle Park slope of the Front Range, and observed it near Mount Whiteley in northwestern Middle Park, at about 8,500 feet—both localities being in the Canadian zone. Near Idlewild this small trailing vine was abundant on mossy slopes in the damp Engelmann spruce forest.

Symphoricarpos occidentalis. Wolfberry.

The wolfberry is a very abundant shrub on the banks of the South Platte River near Sterling, where it forms dense thickets about 2 feet high. I found it also at Golden. Rydberg records it from a number of localities along the eastern base of the foothills.

Symphoricarpos oreophilus. Snowberry.

A dense scrubby growth of this small-leaved snowberry covers many open mountain slopes in the Transition zone, particularly in western Colorado. It is rarely found in forests or damp situations, but grows rampant on dry, rocky hillsides and mesas. It occurs in abundance in the following localities: Hahns Peak region below 8,500 feet; Escalante Hills; divide between Bear and White Rivers; southwest of Rangely; Book Plateau above 6,500 feet; canyon of the Grand above Glenwood Springs; Mount Whiteley; West Elk Mountains east of Crawford; Vernal Mesa; Somerset; Uncompahgre Plateau; Lone Cone; and Ute Peak.

Distegia involucrata. Involucred Fly Honeysuckle.

Throughout the mountains this honeysuckle is a common and conspicuous undershrub in the forests of the middle slopes. It usually grows in damp situations and is particularly common along streams, where it reaches its rankest growth. I have found it as low as 7,000 feet along cold streams in various parts of the mountains, and it was common at 10,500 feet on the upper reaches of Cebolla Creek in the San Juan Mountains southeast of Lake City. The dark purplish or blackish berries usually fall in late August.

Artemisia tridentata. Sagebrush.

The common sagebrush is almost omnipresent on the higher plains of western Colorado and also in most of the higher mountain parks up to 10,000 feet, but was not noted on the plains east of the mountains. It grows on an average about 2 feet high, but under favorable conditions attains a height of 6 feet or more. The rankest growth I have observed was on the banks of sandy arroyos near Lay, Routt County, where many of the shrubs were 8 or 10 feet in height. *A. tridentata* is abundant at the following localities: Glendevey, Laramie Valley; Livermore; North Park plains (see fig. 39); Hahns Peak to Slater; Snake River Valley; Iron Springs Divide; Lily Park; southwest of Rangely; Plateau Creek; De Beque to Glenwood and Dotsero, Grand River Valley; Wolcott; Piney Divide; McCoy; Egeria Park; parks in Gore Mountains; Middle Park; Roaring Fork Valley to Aspen; Uncompahgre Plateau; Lone Cone; Lone Mesa; Naturita; Coventry; Cerro Ridge; Somerset; Sapinero; Gunnison; Creede; Poncha Pass; Buena Vista; Leadville; Hotchkiss; Saguache; Bayfield; Arboles; and McElmo.

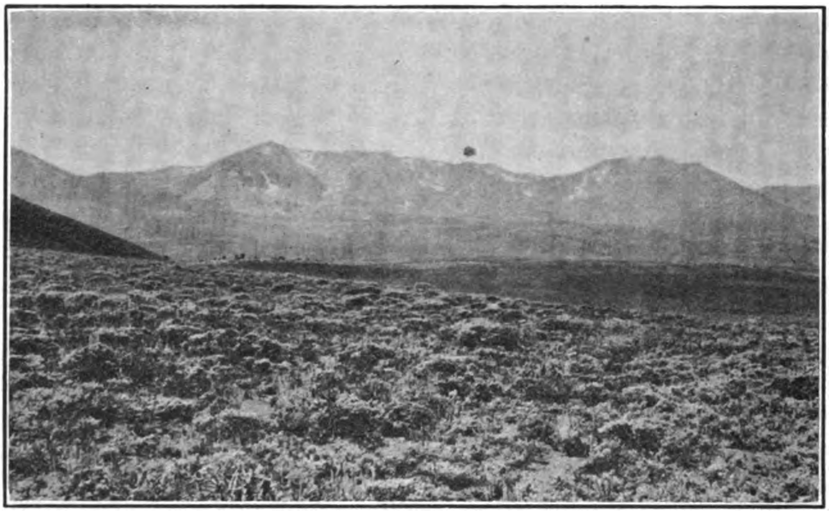

FIG. 39.—Desert sagebrush (*Artemisia tridentata*) on plains near Higho, North Park. (Park Range in the distance.)

Artemisia cana.

This sage occurs in Colorado at a somewhat higher average elevation than *A. tridentata,* although at many points the two species grow together. It was found in abundance at Coulter, Middle Park; near Toponas, Egeria Park; on the Uncompahgre Plateau; and on the lower slopes of Lone Cone, in the San Miguel Mountains. Rydberg records it from Breckenridge; Marshall Pass; Hayden Flats, Routt County; Hebron, North Park; and Timnath.

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[illegible]
Sept. 14, 1911.
J.H. Riley.

U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF BIOLOGICAL SURVEY
HENRY W. HENSHAW, *Chief*

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REVISION OF THE SPINY POCKET MICE

(Genera HETEROMYS and LIOMYS)

BY

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Biological Survey,
Washington, D. C., April 15, 1911.

Sir: I have the honor to transmit herewith, for publication as North American Fauna No. 34, a Revision of the Spiny Pocket Mice (genera Heteromys and Liomys), by Edward A. Goldman, field naturalist, Biological Survey. The spiny pocket mice are widely distributed in the drier parts of North America, and, although of small size, are of considerable economic importance, owing to the fact that they feed chiefly on seeds, including weed seeds, corn, wheat, and beans. Comparatively little has been known of the relationships and distribution of these animals. Hence the need of the present revision, which brings the subject up to date and will materially lessen the labors of those who have occasion to study and identify the animals.

Respectfully,

Henry W. Henshaw,
Chief, Biological Survey.

Hon. James Wilson,
Secretary of Agriculture.

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No. 34. NORTH AMERICAN FAUNA. Sept., 1911.

REVISION OF THE SPINY POCKET MICE.

(Genera HETEROMYS and LIOMYS.)

By EDWARD A. GOLDMAN.

INTRODUCTION.

The spiny pocket mice of the genera *Heteromys* and *Liomys* belong to the family Heteromyidæ, a group of mammals widely distributed, especially in the drier parts of North America. The other members of the family are the pocket mice of the genus *Perognathus* and the kangaroo rats of the genera *Dipodomys*, *Perodipus*, and *Microdipodops*. Although of small size, these rodents are of considerable economic importance in many regions, owing to their excessive numbers and their habit of feeding on grain and other seed, which they carry off in their cheek pouches.

In *Heteromys* and *Liomys* the pelage is composed mainly of flattened and grooved bristles or spines, which readily distinguish these genera from all the others. The genus *Liomys*, with numerous forms, overlaps the other Heteromyidæ in geographic range, but gradually replaces them from southern Texas southward through Mexico. The genus *Heteromys* includes an austral group of species, some of which range in northern South America.

HISTORY AND MATERIAL.

A species of *Heteromys* was first described and figured under the name *Mus anomalus*, from the island of Trinidad, by John Vaughn Thompson.[1] In a paper read March 3, 1812, before the Linnæan Society of London he gave an excellent description, which was published in the Transactions of the Society three years later. Thompson was well aware of the peculiar characters of the animal, and regarded it as an anomaly serving as a connecting link between *Mus* and *Hystrix*, but hardly worthy of generic separation. In 1817 Desmarest proposed provisionally the generic name *Heteromys*, with *Mus anomalus* Thompson as type.[1]

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[1] Trans. Linn. Soc. Lond., XI, pp. 161-163, pl. 10, 1815.

Five years later he was still somewhat doubtful of the applicability of the generic name *Heteromys*,[2] and placed *Mus anomalus* under *Cricetus anomalus*, the name he had applied to the animal in 1817. Lesson found it advantageous to separate *Heteromys* from *Cricetus* and used the name *Heteromys thompsonii* for *Mus anomalus*.

In 1843 Dr. J. E. Gray[3] referred to a specimen from Coban, Guatemala, which he named *Heteromys desmarestiana* but did not describe. This nomen nudum became a valid name in 1868, when Dr. Gray published his Synopsis of the Species of Saccomyinæ, or Pouched Mice, in the Collection of the British Museum. In this paper six species of *Heteromys* were recognized, four being added to the already named *H. anomalus* and *H. desmarestianus*. A few others were described at intervals, and in 1893 the species were first divided by Thomas[4] into groups based on characters presented by the soles of the hind feet, whether naked or hairy posteriorly and five- or six-tuberculate. These characters were also used by Allen[5] in tabulating a revised list of species in 1897. Meanwhile a large collection was accumulated by the Biological Survey; and in a paper published in 1902 Merriam added 20 new species and subspecies to the general group, more than doubling the number then known. Fifteen of the new forms were placed in a new genus, *Liomys*, and one was assigned to a new subgenus, *Xylomys*.

The present revision is the result of a study of the spiny pocket mice in the collection of the Biological Survey, now numbering nearly 1,000 specimens, supplemented by about 130 in the United States National Museum and from various sources. For the use of types and topotypes in other American collections acknowledgments are due to Dr. J. A. Allen, American Museum of Natural History; to Mr. Outram Bangs, Museum of Comparative Zoology; and to Dr. D. G. Elliot, Field Museum of Natural History. In addition I am indebted to Mr. Gerrit S. Miller, jr., for notes and comparison of specimens with the types in European museums.

HABITS AND ECONOMIC STATUS.

The habits of all the spiny pocket mice, so far as known, are very similar, but modified to a certain extent by the varying conditions of local environment. Like many other small rodents, they are nocturnal and so shy that their presence in large numbers is readily overlooked. They inhabit widely differing faunal areas, but everywhere burrow in the ground under bushes, trees, rocks, logs, or other shelter, and generally are most numerous in such cover along the borders of fields. The entrances to the burrows are inconspicuous, opening, as they commonly do, under thick beds of leaves, logs, or rocks; small quantities of earth are thrown out about them from time to time, but not usually forming a definite mound. These pocket mice reach their greatest abundance in semiarid, partially wooded regions, both plains and mountain slopes being well populated with them. Some species of *Heteromys*, however, inhabit humid heavily forested areas apparently throughout middle America. From three to five young are produced at a birth, four being the usual number. While the young seem more numerous in spring and early summer than at other times, it is evident that the animals breed throughout the year.

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[1] Nouv. Dict. Hist. Nat., XIV, pp. 180-181, 455, 1817.

[2] Mammalogie, II, pp. 313-314, 1822.

[3] Proc. Zool. Soc. Lond., p. 79, 1843.

[4] Ann. Mag. Nat. Hist., ser. 6, XI, pp. 329-330, April, 1893.

[5] Bull. Amer. Mus. Nat. Hist., IX, p. 57, March 15, 1897.

The food of the spiny pocket mice consists largely of seeds. These are of great variety and include seeds of weeds and many composite plants, corn and wheat, beans and castor beans, supplemented by fragments of green leaves and short sections of twigs. Individuals taken in the vicinity of fields frequently have the cheek pouches filled with grain. Thompson relates in his description of *H. anomalus* that in the island of Trinidad ''they do incalculable mischief in farms and granaries; for, not satisfied with what they can eat on the spot, they stow away and carry off in their cheek pouches no inconsiderable quantity [of grain] to be deposited in their retreats for times when food is not to be procured from without." While apparently not so injurious to crops as some other rodents, these mice, in some places, are among the most numerous of the small mammals, and their food habits, as well as those of the great family to which they belong, should be better known.

COLOR AND PELAGES.

Color variation in the group as a whole is considerable, but certain shades, mainly grays, extend with slight modification through assemblages of related species. The general color of the upperparts depends largely on that of the tips of the spiny element in the pelage; the tips range from light gray to black. The slender hairs interspersed among the spines and often reaching beyond them vary from plain gray to rich orange buff, and may or may not greatly alter the general tone. The general color may be affected also by climatic conditions or a forested environment. The forms inhabiting heavily wooded areas are usually darker than those which live in more open or semidesert situations. An ochraceous or orange buffy lateral line is present in some species and absent in others. The underparts are white.

The pelage of the young at birth consists of fine hairs and flattened, anteriorly grooved bristles, which are quite soft. This juvenal coat is replaced in most species by the spiny adult pelage when the animals are one-half to three-fourths grown; in *H. nelsoni* and perhaps in *H. bicolor* the juvenal coat is permanent. The adult pelage usually appears first in spots on the head and near the middle of the back, gradually spreading with a sharp line of demarcation until the entire body is covered. The molting season is very irregular, partly owing to the prolongation of the breeding period through the entire year. As a rule the adults are at the molting stage in early summer, but fully grown individuals in worn and fresh pelages may be seen together at almost any time. In some species the new coat seems to replace the old almost imperceptibly; in others it appears first on the head, passing progressively backward. Occasionally an irregular patched appearance results, or the change may resemble that which takes place when the adult pelage is acquired. During wear the slender hairs are abraded and the spines thus more exposed give the animal a somewhat darker color than when in the fresh coat.

MEASUREMENTS.

All measurements of specimens, unless otherwise stated, are in millimeters. With a few exceptions, usually stated, the external measurements were taken in the flesh by the collector, as follows: *Total length* (nose to end of terminal tail vertebra); *tail vertebræ* (upper base of tail to end of terminal tail vertebra); *hind foot* (heel to end of longest claw). While adult males average slightly larger than females, the difference is scarcely appreciable in the small series usually available. The external and cranial measurements given are, therefore, of series which may include specimens of both sexes. The following cranial measurements have been taken:

Greatest length.—The length from the tip of the nasals to the supraoccipital in the median line over the foramen magnum.

Zygomatic breadth.—The greatest distance across the zygomata.

Interorbital breadth.—The least distance between the orbits.

Length of nasals.—The greatest length of the nasals.

Width of braincase.—The distance between the outer sides of the squamosals immediately in front of the projection of the auditory meatus.

Alveolar length of upper molar series.—The greatest length of the upper molariform tooth row, at the alveolar border.

SUBGENERA AND MINOR GROUPS.

The genus *Heteromys* has been divided into two subgenera. *Heteromys*, the typical subgenus, contains all the species except *H. nel-*

soni, which is placed in the monotypic subgenus *Xylomys*. The latter is distinguished externally by large size and by the softness of its pelage. The genus *Liomys* is undivided subgenerically, but may be separated into three well-defined groups: the *irroratus* group, with light grayish coloration and five-tuberculate soles of hind feet; the *pictus* group, characterized by rich orange rufous lateral lines and six-tuberculate soles of hind feet; and the *crispus* group, including small species with short tails, plain coloration, and peculiar dental characters.

In the present revision 14 species and subspecies are assigned to the genus *Heteromys* and 28 to the genus *Liomys*, of which one species of *Heteromys* and two forms of *Liomys* are characterized for the first time.

List of Species and Subspecies, with Type Localities.

Genus HETEROMYS.

H. anomalus group:	
Heteromys anomalus (Thompson)	Island of Trinidad, West Indies.
jesupi Allen	Near Minca, Santa Marta District, Colombia.
australis Thomas	San Javier, lower Cachabi River, Ecuador.
bicolor (Gray)[1]	Venezuela.
H. desmarestianus group:	
Heteromys desmarestianus Gray	Coban, Guatemala.
desmarestianus griseus Merriam	Mountains near Tonala, Chiapas, Mexico.
longicaudatus Gray	"Mexico."
goldmani Merriam	Chicharras, Chiapas, Mexico.
lepturus Merriam	Mountains near Santo Domingo, Oaxaca.
temporalis sp. nov	Motzorongo, Vera Cruz, Mexico.
repens Bangs	Boquete, Volcan de Chiriqui, Panama.
fuscatus Allen	Tuma, Nicaragua.
gaumeri Allen and Chapman	Chichen Itza, Yucatan.

Subgenus XYLOMYS.

Heteromys nelsoni Merriam	Pinabete, Chiapas, Mexico.

Genus LIOMYS.

L. pictus group:	
Liomys pictus (Thomas)	Mineral San Sebastian, Jalisco.
pictus escuinapæ (Allen)	Escuinapa, Sinaloa, Mexico.
pictus sonorana Merriam	Alamos, Sonora, Mexico.
pictus plantinarensis Merriam	Plantinar, Jalisco, Mexico.
pictus parviceps Goldman	La Salada, Michoacan, Mexico.
pictus rostratus Merriam	Near Ometepec, Guerrero, Mexico.
pictus phæurus Merriam	Pinotepa, Oaxaca, Mexico.
pictus isthmius Merriam	Tehuantepec, Oaxaca, Mexico.
pictus veræcrucis Merriam	San Andres Tuxtla, Vera Cruz, Mexico.
pictus obscurus Merriam	Carrizal, Vera Cruz, Mexico.
annectens (Merriam)	Pluma, Oaxaca, Mexico.

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[1] *Heteromys bicolor* may not belong here.

L. crispus group:	
Liomys crispus Merriam	Tonala, Chiapas, Mexico.
crispus setosus Merriam	Huehuetan, Chiapas, Mexico.
vulcani (Allen)	Volcan de Chinandega, Nicaragua.
heterothrix Merriam	San Pedro Sula, Honduras.
salvini (Thomas)	Dueñas, Guatemala.
salvini nigrescens (Thomas)	"Costa Rica."
adspersus (Peters)	"Panama."
L. irroratus group:	
Liomys irroratus (Gray)	"Mexico, State of Oaxaca."
irroratus torridus Merriam	Cuicatlan, Oaxaca, Mexico.
irroratus minor Merriam	Huajuapam, Oaxaca, Mexico.
irroratus alleni (Coues)	Rio Verde, San Luis Potosi, Mexico.
irroratus pretiosus subsp. nov.	Metlaltoyuca, Puebla, Mexico.
irroratus texensis Merriam	Brownsville, Texas.
irroratus canus Merriam	Near Parral, Chihuahua, Mexico.
irroratus jalicensis (Allen)	Las Canoas, 20 miles west of Zapotlan, Jalisco, Mexico.
bulleri (Thomas)	La Laguna, Sierra de Juanacatlan, Jalisco, Mexico.
guerrerensis sp. nov	Omilteme, Guerrero, Mexico.

Key to Genera and Subgenera.

a. Posterior molars narrower than premolars.
  b. Posterior loop in crown of upper premolar with a deep reentrant angle directed inward and backward from anterior border; interpterygoid fossa narrowing gradually to a rather acute point anteriorly........................*Heteromys*.
  b'. Posterior loop in crown of upper premolar with anterior border concave; interpterygoid fossa broad and rounded anteriorly.........................*Liomys*.
a'. Posterior molars equal to or broader than premolars....................*Xylomys*.

Key to Species and Subspecies.

[Based on typical adults.]

I. Subgenus HETEROMYS.

a. Pelage composed of bristles mingled with slender hairs.
  b. Sole of hind foot naked posteriorly.
    c. Parietals reaching laterally across temporal ridges.
      d. Inner side of forearm clouded with dusky.
        e. Tail more than 150; slender hairs on dorsum dull ochraceous buffy. (Venezuela; Island of Trinidad.)........................*H. anomalus* (p. 16)
        e'. Tail less than 140; slender hairs on dorsum clear grayish. (Ecuador.) *H. australis* (p. 18)
      d'. Inner side of forearm white.
        e. Outer sides of frontals widely overhanging orbits. (Mexico to Panama.)
          f. Buffy lateral line present.
            g. Ankles white above.
              h. Nasals moderately broad anteriorly, narrowing gradually near middle.
                i. Back blackish. (West-central Guatemala; Chiapas, north of Sierra Madre; mountains of southern Tabasco.) *H. desmarestianus* (p. 20)
                i'. Back grayish. (Western Chiapas; eastern Oaxaca.) *H. d. griseus* (p. 22)

- *h'*. Nasals very broad anteriorly, narrowing abruptly near middle. (Lowlands of Tabasco.)..................*H. longicaudatus* (p. 23)
- *g'*. Ankles dusky all round. (Eastern Oaxaca and southern Vera Cruz.) *H. lepturus* (p. 25)
- *f'*. Buffy lateral line absent.
  - *g*. Hind foot less than 35.
    - *h*. Nasals reaching posteriorly beyond premaxillæ. (Panama.) *H. repens* (p. 27)
    - *h'*. Nasals not reaching posteriorly beyond premaxillæ. (Nicaragua.) *H. fuscatus* (p. 28)
  - *g'*. Hind foot more than 37. (Southern Chiapas.)..*H. goldmani* (p. 24)
- *e'*. Outer sides of frontals narrowly overhanging orbits. (Colombia.) *H. jesupi* (p. 18)
- *c'*. Parietals not reaching laterally across temporal ridges. (Vera Cruz.) *H. temporalis* (p. 26)
- *b'*. Sole of hind foot hairy from near posterior tubercle to heel. (Yucatan; Campeche.)...*H. gaumeri* (p. 29)
- *a'*. "Fur somewhat harsh but not in the least bristly." (Venezuela.) *H. bicolor* (p. 19)

II. Subgenus XYLOMYS (monotypic).

III. Genus LIOMYS.

[Based on typical adults.]

- *a*. Sole of hind foot five-tuberculate (*irroratus* group).
  - *b*. Back mainly mouse gray.
    - *c*. Interparietal suboval.
      - *d*. Nasals normally truncate posteriorly.
        - *e*. Hind foot more than 30.
          - *f*. Anterior nares not much inflated.
            - *g*. Paler; hind foot usually more than 33. (Southern Chihuahua; Durango; northwestern Zacatecas.)..............*L. i. canus* (p. 60)
            - *g'*. Darker; hind foot usually 32 or less.............*L. i. alleni* (p. 56)
          - *f'*. Anterior nares much inflated. (Tropical lowlands in northern Vera Cruz, Puebla, Queretaro, and eastern San Luis Potosi.) *L. i. pretiosus* (p. 58)
        - *e'*. Hind foot usually less than 30.
          - *f*. Hind foot 28 or more.
            - *g*. Interparietal more than twice as wide as long. (Central Jalisco; northwestern Michoacan.)........................*L. i. jalicensis* (p. 60)
            - *g'*. Interparietal less than twice as wide as long. (Southern Texas; Tamaulipas; eastern Nuevo Leon.)..........*L. i. texensis* (p. 59)
          - *f'*. Hind foot less than 28. (Northwestern Oaxaca; northeastern Guerrero.) *L. i. minor* (p. 56)
      - *d'*. Nasals normally emarginate posteriorly. (Known ranges south of 19° north latitude.)
        - *e*. Hind foot more than 30. (Central and eastern Oaxaca.) *L. irroratus* (p. 53)
        - *e'*. Hind foot less than 30. (Northern Oaxaca; southern Puebla; Morelos; eastern Guerrero.)................................*L. i. torridus* (p. 55)
    - *c'*. Interparietal subtriangular. (Sierra de Juanacatlan, Jalisco.) *L. bulleri* (p. 61)
  - *b'*. Back deep glossy black. (Mountains of central Guerrero.) *L. guerrerensis* (p. 62)

a′. Sole of hind foot normally six-tuberculate (*pictus* and *crispus* groups).
  b. Orange buffy lateral line present (*pictus* group).
    c. Hind foot not more than 30.
      d. Hind foot more than 25.
        e. Tail whitish below to near tip.
          f. Ground color of back grayish. (Pacific slope.)
            g. Interparietal subtriangular.
              h. Nasals emarginate posteriorly.
                i. Forearm normally edged with gray or buffy along outer side.
                  j. Ground color of upperparts paler gray. (Southern Sinaloa and Tepic.) .... *L. p. escuinapæ* (p. 35)
                  j′. Ground color of upperparts darker gray. (Western and southern Jalisco; northwestern Michoacan.) *L. p. plantinarensis* (p. 37)
                i′. Forearm entirely white .... *L. p. isthmius* (p. 41)
              h′. Nasals truncate posteriorly .... *L. pictus* (p. 33)
            g′. Interparietal suboval .... *L. p. rostratus* (p. 39)
          f′. Ground color of back blackish. (Atlantic slope of Isthmus of Tehuantepec.) .... *L. p. veraecrucis* (p. 42)
        e′. Tail dark all round on terminal half .... *L. p. phaeurus* (p. 40)
      d′. Hind foot less than 25 .... *L. p. parviceps* (p. 38)
    c′. Hind foot more than 30.
      d. Hind foot less than 32.
        e. Back blackish. (South-central Vera Cruz from the Papaloapam Valley to near Jalapa.) .... *L. p. obscurus* (p. 44)
        e′. Back grayish. (Southern Sonora; northern Sinaloa; southwestern Chihuahua; western Durango.) .... *L. p. sonorana* (p. 36)
      d′. Hind foot 32 or more. (Sierra Madre of Guerrero and southwestern Oaxaca.) *L. annectens* (p. 45)
  b′. Orange buffy lateral line absent (*crispus* group).
    c. Sole of hind foot hairy posteriorly.
      d. Known ranges in Mexico.
        e. Color paler; skull smaller. (Western Chiapas.) ..... *L. crispus* (p. 46)
        e′. Color darker; skull larger. (Southern Chiapas.) .... *L. c. setosus* (p. 47)
      d′. Known ranges in Central America.
        e. Upperparts not distinctly buffy.
          f. Forearm edged with slaty gray.
            g. Color paler. (Guatemala.) .... *L. salvini* (p. 50)
            g′. Color darker. (Costa Rica.) .... *L. s. nigrescens* (p. 51)
          f′. Forearm nearly or entirely pure white. (Nicaragua.) *L. vulcani* (p. 48)
        e′. Upperparts distinctly buffy. (Honduras.) .... *L. heterothrix* (p. 49)
    c. Sole of hind foot naked posteriorly. (Panama.) .... *L. adspersus* (p. 51)

Genus **HETEROMYS** Desmarest.

Heteromys Desmarest, Nouv. Dict. Hist. Nat., XIV, pp. 180–181, 455, 1817. Type *Mus anomalus* Thompson.
Saccomys F. Cuvier, Mem. Mus. Hist. Nat., Paris, X, pp. 419–428, Pl. XXVI, 1823.
Dasynotus Wagler, Nat. Syst. Amphib., p. 21, 1830.

Generic characters.—Pelage composed of flattened, anteriorly grooved bristles or spines (except possibly in *H. bicolor*), mingled with slender hairs; tail usually longer than head and body, not conspicuously crested or penciled at tip; sole of hind foot five- or six-tuberculate, naked at least to posterior tubercle. Skull elongated; mastoids rather small, appearing externally entirely posterior to auditory meatus; audital bullæ not overlapped by pterygoids; interpterygoid fossa V-shaped, narrowing gradually to a rather acute point anteriorly. Front of upper incisors without grooves; molariform teeth, except lower premolar, with three more or less distinct roots, the two posterior in the upper premolar usually fused in some species; lower premolar with two roots. Molar crowns in early life completely divided by a transverse sulcus into two parallel enamel loops, the grinding surface becoming flat, and the loops uniting first at inner ends of upper row and outer ends of lower row, and continued wear obliterating sulcus or leaving a central enamel island.

Subgenus **HETEROMYS** Desmarest.

Type.—*Mus anomalus* Thompson, from Trinidad, West Indies.

Distribution.—Tropical or subtropical portions of continental America from southern Mexico to Ecuador, also Island of Trinidad, West Indies.

Subgeneric characters.—Pelage hispid (except possibly in *H. bicolor*); tail thinly haired; hind foot naked posteriorly (except in *gaumeri*), six-tuberculate; inner sides of forearms pure white or clouded with dusky. Braincase rather flat; temporal ridges usually distinct; upper surface of maxillary root of zygoma triangular; parietals not reaching laterally along lambdoid crest to mastoids; angle of mandible moderately everted. Last molars slightly narrower than premolars; tubercle over root of lower incisor small; permanent upper premolar with anterior border of posterior loop infolded, the fold forming normally a deep reentrant angle directed inward and backward; additional enamel islands present in early life in posterior loops of upper molars and anterior loops of lower molars, but disappearing with advancing age.

Remarks.—In the genera *Heteromys* and *Liomys* the size of the tubercles over roots of lower incisors is correlated with the size of the last lower molars, that is, when the tubercles are large the molars are small and vice versa. The maximum development of the tubercles is reached in the genus *Liomys* and the minimum in the subgenus *Xylomys*. The intermediate position of the typical subgenus is shown by a more evenly balanced condition of these tubercles and molars and the possession of other characters which are more pronounced in *Liomys* and *Xylomys* or shared with only one of them.

The type species of the subgenus and nearly related South American forms seem to show a closer approach to *Liomys* in early obliteration of additional enamel islands in the loops of molariform teeth than do most Central American and Mexican species, which in this respect are rather more like *Xylomys*. *H. gaumeri* differs from all other known members of the genus and agrees with *Liomys* in having the soles of hind feet hairy posteriorly. Relationship to *Liomys* is suggested also by the early disappearance of additional enamel islands in the loops of molariform teeth; but the characters which readily separate *Heteromys* from *Liomys* in the adult state—the more tapering and anteriorly sharply excised interpterygoid fossa and deep reentrant angle in posterior loop of upper premolar, together with other cranial details—place *gaumeri* in the typical genus.

HETEROMYS ANOMALUS GROUP.

HETEROMYS ANOMALUS (Thompson).

TRINIDAD SPINY POCKET MOUSE.

(Pl. I, figs. 4, 4*a*.)

Mus anomalus Thompson, Trans. Linn. Soc. Lond., XI, pp. 161–163, pl. 10, 1815.
Cricetus anomalus Desmarest, Nouv. Dict. Hist. Nat., XIV, p. 180, 1817; Mammalogie, pt. 2, pp. 313–314, 1822.
Heteromys thompsonii Lesson, Manuel de Mammalogie, p. 264, 1827.
Heteromys anomalus Gray, Proc. Zool. Soc. Lond., p. 203, 1868.
Heteromys melanoleucus Gray, Ibid., p. 204, 1868. From Venezuela (not Honduras).[1] Type in Brit. Mus.

Type locality.—Island of Trinidad, West Indies.

Distribution.—Island of Trinidad and Venezuela.

General characters.—Size medium for subgenus *Heteromys;* tail longer than head and body, thinly haired, sharply bicolored; buffy lateral line absent; sole of hind foot naked, six-tuberculate. Related to *H. jesupi*, but darker; inner sides of forearms more or less clouded with dusky, instead of white, as in *jesupi*.

Color.—*Fresh pelage:* Upperparts dark mouse gray, mixed with blackish on median dorsal area, faintly grizzled with dull buffy hairs; underparts and feet white; outer sides of legs, sometimes including forearms all around, mouse gray; grayish of hind legs becoming blackish on sides of ankles, leaving heels whitish; ears dusky, without white edging; tail brownish above, whitish below, usually more or less mottled with brownish.

Cranial characters.—Skull medium in size for a *Heteromys*, with heavy flattened rostrum and narrow braincase; anterior nares much inflated; nasals very broad, truncate posteriorly; premaxillæ broad posteriorly, usually reaching beyond nasals; frontals narrow; supraorbital and temporal ridges weakly developed; sagittal area narrow; interparietal pointed elliptical; interpterygoid fossa narrow anteriorly; palatopterygoids slender; audital bullæ small; angle of mandible short, heavy, only slightly everted; tubercle over root of lower incisor small; mandibular toothrow relatively rather broad posteriorly; posterior lobe of upper premolar with anterior border deeply infolded; additional enamel islands in posterior lobes of upper molars disappearing through wear rather early in life. Similar in size and general form to *H. jesupi;* nasals broader posteriorly, squarely truncate, instead of convex or acuminate; premaxillæ reaching posteriorly beyond nasals (exceeded by nasals in *jesupi*); palate narrower.

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[1] See Alston, Biol. Cent.-Amer. Mamm., p. 167; Ann. Mag. Nat. Hist., ser. 5, VI, pp. 118–119, 1880.

Measurements.—Average of five adults from Caura, Island of Trinidad: Total length, 286 (280–298); tail vertebræ, 158 (153–163); hind foot, 34.8 (34–36). *Skull* (average of same): Greatest length, 35 (34.1–36.3); zygomatic breadth, 16 (15.8–16.3); interorbital breadth, 8.3 (7.8–8.5); length of nasals, 13.8 (13.3–14.7); width of braincase, 14.7 (14.5–14.9); alveolar length of upper molar series, 5.2 (5–5.6).

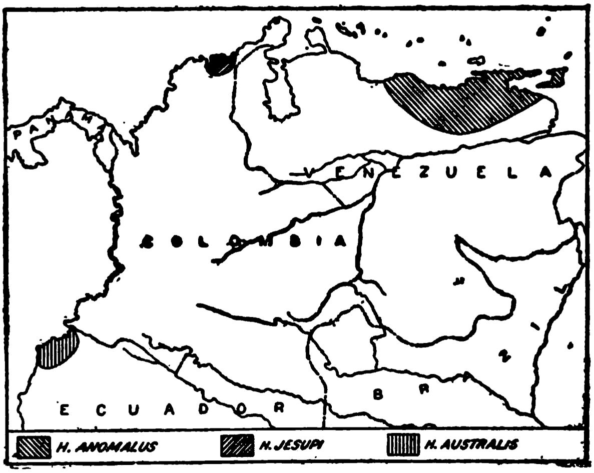

FIG. 1.—Distribution of *Heteromys anomalus*, *H. jesupi*, and *H. australis*.

Remarks.—*H. anomalus*, the type species of the genus, presents less extreme development in cranial characters than is exhibited in some North American species; the broad supraorbital shelves of such forms as *desmarestianus*, *lepturus*, and *goldmani* are represented by slight, narrow ridges, and the additional enamel islands in the posterior lobes of upper molars disappear through wear somewhat earlier in life in *anomalus*. In general characters *anomalus* agrees in many respects with *jesupi* and the two are evidently not very distantly related.

Ten specimens, including a number of perfect skulls of adults with imperfect skins from Los Palmales, San Julian, Macuto, and Quebrada Seca, in northern Venezuela, assumed to be like "*melanoleucus*," do not seem separable from typical *anomalus*.

Specimens examined.—Total number 26, from the following localities:

Trinidad: Caparo, 3; Caura, 11; Princestown, 2.
Venezuela: Los Palmales, 5; Macuto, 1; San Julian, 3; Quebrada Seca, 1.

HETEROMYS JESUPI Allen.

JESUP SPINY POCKET MOUSE.

(Pl. II, figs. 1, 1*a*.)

Heteromys jesupi Allen, Bull. Amer. Mus. Nat. Hist., XII, pp. 201–202, Dec. 20, 1899.

Type locality.—Near Minca, Santa Marta district, Colombia (altitude 1,000 feet). Type No. 15347, ♀ adult, American Museum of Natural History, collected by H. H. Smith, July 30, 1899.

Distribution.—Mountain slopes of the Santa Marta district in northern Colombia.

General characters.—Similar to *H. anomalus*, but paler; inner sides of forearms white, instead of clouded with dusky; buffy lateral line absent, and hind foot naked and six-tuberculate, as in *anomalus*.

Color.—Fresh pelage: Upperparts mouse gray, mixed with blackish on median dorsal area, thinly grizzled with ochraceous buffy hairs; outer sides of legs pale mouse gray, this color becoming darker and reaching down over sides of ankles, usually including heels; ears dusky without distinct white edging; tail brownish above, dull whitish below.

Cranial characters.—Skull much like that of *H. anomalus;* nasals narrower posteriorly, convex or acuminate instead of truncate; premaxillæ not reaching beyond posterior plane of nasals (passing this plane in *anomalus*); interparietal with a small posterior, median notch (absent in *anomalus*); palate broader.

Measurements.—Type (from original description): Total length, 330; tail vertebræ, 163; hind foot, 33. Average of six females: 292; 160; 34. *Skull* (average of two adults): Greatest length, 35.6 (35.2–36.1); zygomatic breadth, 16.4 (16.4–16.5); interorbital breadth, 8.3 (8.2–8.5); length of nasals, 14.8 (14.4–15.2); width of braincase, 14.9 (14.9–15); alveolar length of upper molar series, 5.5 (5.5–5.6).

Remarks.—This species is evidently rather nearly related to the type species of the genus *H. anomalus* of Trinidad and northern Venezuela.

Specimens examined.—Total number 8, from the following localities:

Colombia: Minca, 3 (including type); Bonda, 1; El Libano Plantation, 1; Mamatoca, 1; Masinga Vieja, 1; Onaca, 1.

HETEROMYS AUSTRALIS Thomas.

SOUTHERN SPINY POCKET MOUSE.

(Pl. II, figs. 2, 2*a*.)

Heteromys australis Thomas, Ann. Mag. Nat. Hist., ser. 7, VII, p. 192, Feb., 1901.

Type locality.—San Javier, lower Cachabi River, Ecuador (altitude 65 feet). Type, ♀, collected by G. Flemming and R. Miketta, June 23, 1900.

Distribution.—Known only from the type locality, near the Pacific coast in extreme northern Ecuador.

General characters.—Size medium, tail about equal to head and body, thinly haired, nearly unicolor; pelage very short and hispid; color dark; feet clouded with dusky; sole of hind foot naked, six-tuberculate. Somewhat like *jesupi* and *repens* externally, but smaller and darker and not closely related.

Color.—*Fresh pelage:* Upperparts varying from very dark mouse gray to blackish slate, darkest on median dorsal area, finely and inconspicuously grizzled with slender grayish hairs; outer sides of legs blackish; forearms, ankles, and base of tail more or less black all round; fore and hind feet dull whitish, clouded with black; ears dusky, without white edging; tail brownish black above, slightly paler below.

Cranial characters.—Skull rather short and broad, with large inflated braincase, short, heavy rostrum, anteriorly spreading zygomata, and very small audital bullæ. In general form somewhat similar to that of *jesupi*, but smaller; braincase more fully inflated; parietal bulging noticeably, leaving a narrow median depression between them, not much prolonged laterally along lambdoid suture; frontal and sagittal areas broader; premaxillæ narrower posteriorly, more nearly conterminous with nasals (nasals usually reaching beyond premaxillæ in *jesupi*); zygomata more squarely and relatively more widely spreading anteriorly; palate with a distinct ridge along median line between premolars; bullæ much smaller, more angular, and tapering antero-internally; dentition about as in *jesupi*.

Measurements.—Type (from original description): Head and body, 135; tail, 137; hind foot, 33. Average of four adult topotypes: 128; 128; 30 (hind foot without claw?). *Skull* (average of three adults): Greatest length, 33.6 (33.2–34.1); zygomatic breadth, 16.2 (16–16.3); interorbital breadth, 8.6 (8.3–8.9); length of nasals, 13.2 (12.8–13.7); width of braincase, 14.7 (14.5–14.9); alveolar length of upper molar series, 5.1 (5–5.1).

Remarks.—*H. australis* is a strongly marked species apparently nearer in cranial characters to *jesupi* and *anomalus* than to *repens*, but not requiring close comparison with either. No other member of the genus is known to range so far south.

Specimens examined:

Ecuador: San Javier (type locality), 4.

HETEROMYS BICOLOR (Gray).

Bicolored Spiny Pocket Mouse.

Perognathus bicolor Gray, Proc. Zool. Soc. Lond., 202, 1868.
Heteromys bicolor Alston, Ann. Mag. Nat. Hist., VI, pp. 118–119, 1880.

Type locality.—Venezuela (not "Honduras").[1] Type in British Museum, sent by Dyson from Venezuela.

Distribution.—Range unknown.

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[1] Ann. Mag. Nat. Hist. VI, 118-119, 1880.

General characters.—(Amended description by Alston.)[1] "Ears with the notch apparently bounded by two lobes; tail clad with short, fine, stiffish hairs; fur rather long, sparse, with no underfur, somewhat harsh, but not in the least bristly. Color above uniform dark brown, which extends to the outside of the limbs; feet dusky, edges of cheek-pouches and all the lower parts white, the hairs all uniform in color throughout their length. Approximate measurements (of the mounted specimen)—length of head and body about 3.75 inches, of tail 3 inches, of hind foot 1 inch."

Remarks.—In describing *Perognathus bicolor* (=*Heteromys bicolor*), Gray seems to have confused his type with some other specimen, as shown by Alston; hence Alston's amended description is here substituted for the original one. The type of *bicolor* has not been examined by me and may possibly prove to be generically separable from *Heteromys.*

HETEROMYS DESMARESTIANUS GROUP.

HETEROMYS DESMARESTIANUS Gray.

COBAN SPINY POCKET MOUSE.

(Pl. I, figs. 1, 1*a*, 1*b*; Pl. II, figs. 3, 3*a*.)

Heteromys desmarestianus Gray, Proc. Zool. Soc. Lond., p. 204, 1868.

Type locality.—Coban, Guatemala. Type in British Museum.

Distribution.—Mountainous portions of western Guatemala, also northern Chiapas and southern Tabasco, Mexico. Humid Tropical Zone.

General characters.—Size large; tail decidedly longer than head and body, scantily haired; color dark, decidedly darker than *longicaudatus*, but not so dark as *goldmani;* ochraceous buffy lateral line usually faint; ears without white edging; pelage coarse; sole of hind foot naked, six-tuberculate.

Color.—*Fresh pelage:* General color of upperparts between dark mouse gray and slaty black, usually darkest along median line from nose to base of tail, heavily and uniformly grizzled with slender ochraceous buffy hairs; ochraceous buffy lateral line from cheeks to hind legs, distinct in some specimens, almost imperceptible in others; underparts and feet white, this color extending down in a continuous line along inner sides of hind legs; ears thinly covered with short dusky hairs, overlapped anteriorly by a tuft of long blackish bristles; outer sides of forelegs mouse gray tinged with ochraceous buffy, merging above with general color of upperparts; sides of ankles, and sometimes heels, dusky; tail dusky above, whitish below on basal two-thirds, darkening gradually toward tip, which is usually dusky all round.

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[1] Ann. Mag. Nat. Hist., VI, 119, 1880.

Cranial characters.—Skull large—about equal to *longicaudatus* and *lepturus*—high and well arched along median line above, with narrow rostrum, nasals, and interparietal, broad frontals and premaxillæ. In general form much like that of *longicaudatus*, but rostrum narrower, broadening more abruptly to zygomata; nasals less expanded near middle; upper surface of maxillary root of zygomata shorter, less prolonged anteriorly; supraoccipital and temporal ridges strongly developed, shelving over orbits and curving posteriorly across parietals to lambdoid suture; interparietal varying from irregularly oval to pentagonal, the anterior angle prolonged; premaxillæ reaching posteriorly slightly beyond nasals; zygomata only slightly spreading anteriorly, the sides nearly parallel; palatopterygoids long and slender; interpterygoid fossa V-shaped, deeply excised anteriorly; bullæ small; angle of mandible slightly everted; tubercle over root of lower incisor moderately developed; molariform teeth rather small, as usual in the subgenus; posterior lobe of upper premolar with a deep reentrant enamel fold; posterior molars narrower than premolars above and below; additional enamel islands in posterior lobes of upper molariform teeth and anterior lobes of lower molariform teeth present in young, disappearing in anterior molars with advancing age, but persisting, at least in last upper molars, until extreme old age.

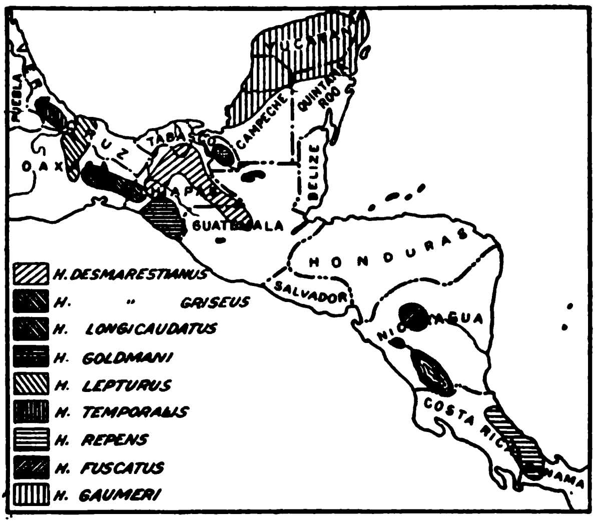

FIG. 2.—Distribution of *Heteromys desmarestianus* and allied forms.

Measurements.—Type:[1] Total length, 260; tail vertebræ, 123 (tip gone); hind foot, 35.4. Average of 5 adult males and females from Tumbala, Chiapas: 302 (272–323); 167 (139–180); 37.5 (37–38). *Skull* (average of 3 adults): Greatest length, 37.3 (37.2–37.4); zygomatic breadth, 16.6 (16.2–17); interorbital breadth, 9.8 (9.6–9.9); length of nasals, 15.1 (15–15.2); width of braincase, 15.5 (15.2–15.9); alveolar length of upper molar series, 5.2 (5–5.7).

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[1] Measured by Gerrit S. Miller, jr.

Remarks.—Mr. Gerrit S. Miller, jr., has compared for me specimens of all the large species of the genus known to occur in Mexico with the type of *desmarestianus.* Specimens from Tumbala, Chiapas, were found to agree very closely with it and are probably nearly typical. The species has a wider known range in Mexico than any other member of the genus, and the agreement in many important characters with *longicaudatus* suggests that the latter may prove to be a rather slightly differentiated offshoot of this more generalized type.

October specimens from Tumbala are in apparently fresh or only slightly worn pelage. Those taken in March and April at Teapa, Tabasco, are in molting condition, the change about complete in some, while others have a growing patch of fresh fur along median dorsal area, below which the sides are ragged and much worn.

Specimens examined.—Total number 17, from localities as follows:

Chiapas: Tumbala, 6; Ocuilapa, 3.
Tabasco: Teapa, 8.

HETEROMYS DESMARESTIANUS GRISEUS Merriam.

GRAY SPINY POCKET MOUSE.

Heteromys griseus Merriam, Proc. Biol. Soc. Wash., XV, p. 42, Mar. 5, 1902.

Type locality.—Mountains near Tonala, Chiapas, Mexico. Type No. 76062, ♂ adult, United States National Museum (Biological Survey collection), collected by Nelson and Goldman, August 15, 1895.

Distribution.—Mountains of western Chiapas and along the Isthmus of Tehuantepec in eastern Oaxaca. Humid Tropical Zone.

General characters.—Size and proportions similar to those of *desmarestianus;* color much grayer; sole of hind foot naked and six-tuberculate as in *desmarestianus.*

Color.—*Fresh pelage:* General color above mouse gray, palest along sides, thickly grizzled with slender ochraceous buffy hairs; buffy lateral line faint; feet and underparts white; outer sides of forearms grayish tinged with pale buff, interrupted across upper part of arms in some specimens by a white area, in others continuous with general color of upperparts; ears and ankles dusky; tail dusky above, whitish below except near end, which is dusky all round.

Cranial characters.—Skull closely resembling that of *desmarestianus,* but somewhat smaller; premaxillæ decidedly narrower and more tapering posteriorly; interparietal slightly shorter antero-posteriorly.

Measurements.—Type: Total length, 325; tail vertebræ, 186; hind foot, 38. Average of 3 adult topotypes: 317 (310–325); 181 (176–186); 37.2 (36–38). *Skull* (average of 4 adults): Greatest length, 36.2 (35.5–36.7); zygomatic breadth, 16.6 (16.1–17.2); interorbital breadth, 9.5 (9.3–9.8); length of nasals, 15.1 (14.5–15.5); width of braincase, 15.3 (14.9–15.7); alveolar length of upper molar series, 5.2 (5-5.2).

Remarks.—This is a paler form evidently closely related to *desmarestianus.* Specimens from Guichicovi, Oaxaca, are darker colored than typical *griseus*, and in slightly broader premaxillæ also show gradation toward *desmarestianus*. The type series collected in August includes several young about two-thirds grown in which the soft coat characteristic of immaturity is beginning to give way to the hispid pelage of adults, the latter pelage appearing in patches on the face and rump.

Specimens examined.—Total number 13, from localities as follows:

Chiapas: Mountains near Tonala (type locality), 10.
Oaxaca: Guichicovi, 3.

HETEROMYS LONGICAUDATUS Gray.

LONG-TAILED SPINY POCKET MOUSE.

(Pl. II, figs. 4, 4*a*.)

Heteromys longicaudatus Gray, Proc. Zool. Soc. Lond., pp. 204–205, 1868.

Type locality.—"Mexico."[1] Type, ♀ adult, in British Museum.

Distribution.—Low coastal plains of Tabasco, Mexico, and probably adjacent portions of Chiapas, southwestern Campeche, and northwestern Guatemala. Humid Tropical Zone.

General characters.—Size large; tail much longer than head and body, very thinly haired; color dark, but not so dark as in *H. desmarestianus*; ochraceous buffy lateral line present, but rather narrow and inconspicuous; sole of hind foot naked, six-tuberculate.

Color.—*Fresh pelage:* General color above between drab and mouse gray, darkest along median line of back, grizzled everywhere with slender ochraceous buffy hairs; pale ochraceous buffy lateral line very faint anteriorly, becoming more distinct across shoulders and along flanks, fading again on hind legs; underparts and feet white; outer sides of fore legs pale ochraceous buffy faintly tinged with dusky, continuous above with lateral line; ears and inner sides of ankles dusky, a dark line passing down along inner sides of legs leaving the heels white; tail dusky above, white below.

Cranial characters.—Skull large, with short heavy rostrum, broad nasals, premaxillæ, and frontals, and narrow zygomata and interparietal. More like that of *H. desmarestianus* than any other Mexican species, but rostrum broader and heavier, broadening more gradually to zygomata; nasals broader near middle; upper surface of maxillary root of zygoma more elongated; interparietal irregularly oval, with a projecting anterior angle; dentition as in *desmarestianus*.

Measurements.—Type:[2] Total length, 295; tail vertebræ, 170; hind foot, 37. An adult female from Montecristo, Tabasco: 312; 170; 36.

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[1] Mr. Gerrit S. Miller, jr., who has compared for me specimens from numerous localities in Mexico with the type of *longicaudatus*, found that one from Montecristo, Tabasco, agrees almost exactly in size, color, and cranial characters.

[2] Measured by Gerrit S. Miller, jr.

Skull (♀ from Montecristo): Greatest length, 37.4; zygomatic breadth, 16.1; interorbital breadth, 9.5; length of nasals, 14.6; width of braincase, 15; alveolar length of upper molar series, 5.5.

Remarks.—Gray's original description of *longicaudatus* includes the following statement: "There is no indication of any yellow streak on the side, between the colors of the back and undersurface." In the single specimen in the Biological Survey collection (No. 100211), which Mr. Miller says "perfectly matches type of *longicaudatus* in color, size (295; 170; 37), and all visible external characters * * *," a pale lateral line is present, but is not so broad and conspicuous as in some species and may have been overlooked by Gray. This specimen represents a form apparently nearest to *desmarestianus*, but differing in paler color and the cranial characters already given. In breadth and general outline of rostrum and nasals it approaches *lepturus*, but the skull departs too widely in other respects to require close comparison.

Specimens examined:

Tabasco: Montecristo, 1.

HETEROMYS GOLDMANI Merriam.

GOLDMAN SPINY POCKET MOUSE.

(Pl. II, figs. 5, 5*a*.)

Heteromys goldmani Merriam, Proc. Biol. Soc. Wash., XV, pp. 41–42, Mar. 5, 1902.

Type locality.—Chicharras, Chiapas, Mexico. Type No. 77576, ♂ adult, United States National Museum (Biological Survey collection), collected by Nelson and Goldman, February 7, 1896.

Distribution.—Heavily forested Pacific slope of Sierra Madre in extreme southern Chiapas, Mexico, and probably adjacent portions of Guatemala. Humid Tropical Zone.

General characters.—Size very large; tail much longer than head and body, thinly haired; color very dark, the slender hairs inconspicuous; buffy lateral line absent; ears without white edging; pelage coarse; sole of hind foot naked, six-tuberculate.

Color.—*Fresh pelage:* General color above dark mouse gray, becoming slaty black over median dorsal area; feet and underparts (including lips and cheek pouches) white, the line of separation along sides very sharp; outer sides of forelegs mouse gray, passing above into general color of upperparts; ears and inner sides of ankles dusky· tail dusky above, whitish below (sometimes pure white at tip).

Cranial characters.—Skull large and angular, with rather flat rostrum, anteriorly spreading zygomata, and broad frontals shelving over orbits. In general form similar to that of *H. desmarestianus*, but larger; rostrum less decurved, flatter above; premaxillæ narrower and more tapering posteriorly, reaching, as in *desmarestianus*, slightly beyond nasals; frontals more prolonged anteriorly along intermaxillary suture; zygomata more spreading anteriorly; interparietal irregularly oval, broader transversely and relatively shorter antero-posteriorly than in *desmarestianus;* angle of mandible slightly everted; upper premolar with posterior lobe deeply infolded anteriorly; additional enamel island in posterior lobe of last upper molar persisting until removed by wear in extreme old age; tubercle over root of lower incisor moderately developed; last molar smaller than premolar. Compared with *temporalis,* the braincase is decidedly narrower and more arched; temporal ridges less widely separated; interparietal more oval, without the small posterior indentation present in *temporalis;* bullæ smaller.

Measurements.—Type: Total length, 347; tail vertebræ, 199; hind foot, 40. Average of four adult topotypes: 342 (335–350); 194 (186–201); 39.5 (38–41). *Skull* (average of five adults): Greatest length, 38.9 (38.2–40.2); zygomatic breadth, 18 (17.4–18.2); interorbital breadth, 9.9 (9–10.5); length of nasals, 16.4 (16–17.3); width of braincase, 15.9 (15.6–16.4); alveolar length of upper molar series, 5.6 (5.4–5.8).

Remarks.—This species, one of the largest of the genus, belongs to the *desmarestianus* group, but is apparently not closely allied to any of its near geographical neighbors. In general color, including the absence of a buffy lateral line, it resembles *temporalis,* but the cranial characters are distinctive.

Specimens examined.—Total number 9, from the following localities:

Chiapas: Chicharras (type locality), 7; Huehuetan, 2.

HETEROMYS LEPTURUS Merriam.

SANTO DOMINGO SPINY POCKET MOUSE.

Heteromys goldmani lepturus Merriam, Proc. Biol. Soc. Wash., XV, p. 42, Mar. 5, 1902.

Type locality.—Mountains near Santo Domingo (a few miles west of Guichicovi), Oaxaca, Mexico. Type No. 73382, ♂ adult, United States National Museum (Biological Survey collection), collected by Nelson and Goldman, June 20, 1895.

Distribution.—Humid, heavily forested mountain slopes and coastal plains in northeastern Oaxaca and southeastern Vera Cruz, Mexico. Humid Tropical Zone.

General characters.—Size large; tail long; general color dark, about as in *desmarestianus,* but ankles dusky all round (white on upper side in *desmarestianus*); ears without white edging, nearly naked; ochraceous buffy lateral line usually present, but narrow; sole of hind foot naked, six-tuberculate.

Color.—*Fresh pelage:* General color above between dark mouse gray and slaty black, darkest over median dorsal area; face and hind legs thickly grizzled with slender ochraceous buffy hairs; lateral line (when present) ochraceous buffy, narrow, extending from shoulder to hind leg; underparts and feet white; ankles all round and ears dusky; outer sides of forelegs and shoulders mouse gray tinged with buffy; tail dusky above, whitish below.

Cranial characters.—Skull large and massive, with heavy rostrum, anteriorly spreading zygomata; very broad frontals and basioccipital, and wide interparietal. General form similar to that of *longicaudatus*, but rostrum longer, more decurved anteriorly; braincase higher arched; premaxillæ broader, reaching farther posteriorly beyond nasals; zygomata more spreading anteriorly; frontals broader, the outer sides more strongly developed as supraorbital shelves; interparietal of similar shape, but wider transversely; temporal ridges curving less sharply inward posteriorly; basioccipital decidedly broader; dentition about as in *longicaudatus*.

Measurements.—Type: Total length, 340; tail vertebræ, 191; hind foot, 39. An adult topotype: 311; 176; 38. *Skull* (average of two adults): Greatest length, 37.4 (36.7–38.2); interorbital breadth, 10.5 (10.1–10.9); length of nasals, 15.4 (14.9–15.9); width of braincase, 15.4 (15.2–15.7); alveolar length of upper molar series, 5.3 (5.2–5.4).

Remarks.—*H. lepturus* is a well-marked species, although in external appearance closely resembling *desmarestianus*. It appears to be nearest in relationship to *longicaudatus*, but in combination of cranial characters differs decidedly from all the other members of the *desmarestianus* group. In some specimens from the lowlands of Vera Cruz and Oaxaca the lateral line is distinct as in the topotypes, while in others even from the same locality it is imperceptible.

Specimens examined.—Total number 8, from localities as follows:

Oaxaca: Mountains near Santo Domingo (type locality), 2; Choapam, 1; Tuxtepec, 1.

Vera Cruz: San Andres Tuxtla, 4.

HETEROMYS TEMPORALIS sp. nov.

Motzorongo Spiny Pocket Mouse.

Type from Motzorongo, Vera Cruz, Mexico. No. 63719 (original No. 5915), ♀ adult, United States National Museum (Biological Survey collection), collected by Nelson and Goldman, Mar. 3, 1894.

Distribution.—Heavily forested eastern basal slopes of mountains in central Vera Cruz, Mexico. Humid Tropical Zone.

General characters.—Size large; tail longer than head and body; color dark, but not so dark as in *goldmani;* slender hairs ochraceous buffy, but inconspicuous; buffy lateral line absent; ears without white edging, nearly naked; inner side of ankle whitish; sole of hind foot naked, six-tuberculate.

Color.—Fresh pelage: General color of upperparts, including outer sides of forelegs to shoulders, mouse gray, varying to slaty black over lower part of face and median dorsal area, the slender ochraceous buffy hairs more abundant on head but only slightly affecting the general tone; underparts and feet white; ankles dusky, except a narrow line along inner side; tail dusky above, whitish below.

Cranial characters.—Skull very large, with slender rostrum and very broad, flat braincase. In general form similar to *goldmani*, but rostrum narrower, braincase broader and flatter; sagittal area much broader; temporal ridges following parietosquamosal suture (crossing parietals in *goldmani*), the area for muscular attachment below the ridges very narrow and not overlapping parietals; interparietal more triangular, the anterior angle more prominent; basioccipital narrower; auditory meatus larger; dentition as in *goldmani*.

Measurements.—Type: Total length, 320; tail vertebræ, 180; hind foot, 37. *Skull* (of same): Greatest length, 39.3; zygomatic breadth, 17.8; interorbital breadth, 10.2; length of nasals, 16.2; width of braincase, 16.8; alveolar length of upper molar series, 5.3.

Remarks.—This form appears to be more closely related to *goldmani* than to its nearer geographical neighbors. The skull, with temporal ridges bounding parietals laterally instead of crossing them, presents a condition not observed elsewhere in the genus.

Specimens examined:

Vera Cruz: Motzorongo (type locality), 3.

HETEROMYS REPENS Bangs.

CHIRIQUI SPINY POCKET MOUSE.

Heteromys repens Bangs, Bull. Mus. Comp. Zool., XXXIX, pp. 45–47, fig. 27, Apr., 1902.

Type locality.—Boquete, southern slope Volcan de Chiriqui, Panama (altitude 4,000 feet). Type No. 10356, ♀ adult, Museum of Comparative Zoology (collection of E. A. and O. Bangs), Cambridge, Mass., collected by W. W. Brown, jr., April 8, 1901.

Distribution.—Panama, and probably also in Costa Rica.

General characters.—Size large; tail slightly longer than head and body, bicolor; color very dark; slender hairs ochraceous buffy in adults; sole of hind foot naked, six-tuberculate. Somewhat like *H. desmarestianus*, but smaller; orange buffy lateral line absent; differing also in cranial characters. Similar in general external appearance to *anomalus* and *jesupi*, but even darker than either, and skull very different.

Color.—Fresh pelage: Upperparts dark mouse gray, shaded with blackish on median dorsal area and grizzled with pale ochraceous buffy hairs; underparts and feet white; lower part of face and outer sides of legs dark mouse gray; heels, sides of ankles, and base of tail blackish; ears dusky without distinct white edging; tail brownish above, dull whitish below, except at base, which is dark all round. *Young* (in first pelage): Face and sides of body very dark mouse gray, becoming blackish slate on median dorsal area, without trace of ochraceous buffy hairs.

Cranial characters.—Skull similar in general to that of *desmarestianus*, but smaller; rostrum broadening more gradually to zygomata; nasals reaching posteriorly beyond premaxillæ (nearly conterminous posteriorly in *desmarestianus*); molariform teeth smaller; supraorbital and temporal ridges well developed, as in *desmarestianus*. Compared with *jesupi* the skull is broader, with rostrum more tapering, less inflated anteriorly, broadening more gradually to zygomata; nasals broader anteriorly; braincase larger, more inflated; supraorbital and temporal ridges more developed; frontals much broader; interparietal narrower transversely; zygomata less squarely spreading anteriorly; molariform teeth smaller.

Measurements.—Type (from original description): Total length, 282; tail vertebræ, 150; hind foot, 33. Average of three adult topotypes: 289; 150; 33. *Skull* (average of two adults): Greatest length, 35.5 (35–36); interorbital breadth, 9.6 (9.4–9.9); length of nasals, 15; width of braincase, 15 (14.8–15.3); alveolar length of upper molar series, 5.1 (4.9–5.4).

Remarks.—*H. repens* is a well-marked form apparently more closely related to *desmarestianus* than to *jesupi* or any other known South American species. Four imperfect specimens, three from Angostura and one from Pacuare, Costa Rica, seem larger and somewhat different in cranial details from *repens*, but are not satisfactorily separable.

Specimens examined.—Total number 11, from the following localities:

Panama: Boquete, 6 (including type); Boqueron, 1.
Costa Rica: Angostura, 3; Pacuare, 1.

HETEROMYS FUSCATUS Allen.

NICARAGUA SPINY POCKET MOUSE.

(Pl. II, figs. 6, 6*a*.)

Heteromys fuscatus Allen, Bull. Amer. Mus. Nat. Hist., XXIV, pp. 652–653, Oct. 13, 1908.

Type locality.—Tuma, Nicaragua. Type No. 28451, ♂ adult, American Museum of Natural History, New York, collected by W. B. Richardson, December 1, 1907.

Distribution.—Central Nicaragua; limits of range unknown.

General characters.—Size and proportions about as in *H. repens;* color similar, but face more blackish; nasals and premaxillæ nearly conterminous posteriorly; sole of hind foot naked to heel, six-tuberculate. Smaller than *H. desmarestianus;* color about the same, but lateral line absent and ankles of type dusky all round as in *H. lepturus*.

Color.—Fresh pelage: General color of upperparts between dark mouse gray and slaty black, darkest over median dorsal area from nose to base of tail, rather heavily and uniformly grizzled with slender ochraceous buffy hairs; outer surface of forearms grayish tinged with buffy; outer surface of hind limbs and ankles all round dark mouse gray or blackish; underparts and feet white; nose and lower part of cheeks blackish; heels whitish; tail blackish above, whitish below, becoming dusky all round near tip.

Cranial characters.—Skull in size about equal to that of *repens,* but nasals and premaxillæ nearly conterminous (nasals reaching posteriorly beyond premaxillæ in *repens*). Rather closely resembling that of *desmarestianus,* but smaller; upper surface of maxillary root of zygoma relatively narrower and weaker; supraorbital ridges well developed and shelf-like, as in *desmarestianus.*

Measurements.—Type (from original description): Total length, 300; tail, 150; hind foot, 30. *Skull* (type): Greatest length, 36.7; zygomatic breadth, 17.3; interorbital breadth, 10; length of nasals, 15.3; width of braincase, 15.6; alveolar length of upper molar series, 5.5.

Remarks.—H. fuscatus is somewhat intermediate in general characters between *repens* and *desmarestianus.* It agrees more closely in size with *repens,* but in general color and many cranial details is much like *desmarestianus.* Specimens from Matagalpa and Chontales are about like the type in color, but instead of wholly dark ankles have a white line along inner surface of leg to foot as in *desmarestianus.*

Specimens examined.—Total number 4, from localities as follows:

Nicaragua: Tuma, 1 (type); Matagalpa, 2; Chontales, 1.

HETEROMYS GAUMERI Allen and Chapman.

Gaumer Spiny Pocket Mouse.

(Pl. II, figs. 7, 7*a*.)

Heteromys gaumeri Allen and Chapman, Bull. Amer. Mus. Nat. Hist., IX, pp. 9–11, Feb., 1897.

Type locality.—Chichen Itza, Yucatan, Mexico. Type No. $\frac{8281}{10401}$, ♂ adult, American Museum of Natural History, New York, collected by Frank M. Chapman, March 17, 1896.

Distribution.—Yucatan and northern parts of Campeche and Quintana Roo, Mexico. Arid and Humid Tropical Zones.

General characters.—Size large; tail longer than head and body; orange buff lateral line very broad and conspicuous; sole of hind foot thinly haired posteriorly, six-tuberculate, the posterior tubercle very small. Not closely related to any known species.

Color.—Partly worn pelage: General color above dark mouse gray heavily grizzled with orange buff, becoming rich orange buff along broad lateral line from sides of face to base of tail; underparts and feet pure white; outer sides of forearms orange buffy, interrupted above by a white line; nose dusky; ears dusky, faintly edged with whitish; tail brownish above, dull white below, with a small blackish terminal tuft of longer hairs.

Cranial characters.—Skull rather long and angular, with supraorbital ridges strongly developed laterally as overhanging shelves. In size similar to *H. longicaudatus*, but rostrum narrower; nasals much less broadly expanded anteriorly; zygomata more spreading; interparietal similar in shape, but broader transversely; molariform teeth smaller; audital bullæ larger.

Measurements.—Type (from original description): Total length, 292; tail vertebræ, 162; hind foot, 32. An adult male from type locality: 277; 155; 35. Average of three adults from Tunkas (near type locality): 297 (295–300); 163 (160–166); 34.5 (34–35). *Skull* (average of same): Greatest length, 36.4 (35.9–36.9); zygomatic breadth, 16.5 (16.4–16.5); interorbital breadth, 8.5 (8.2–8.7); length of nasals, 14.8 (14.1–15.2); width of braincase, 14.9 (14.7–15.2); alveolar length of upper molar series, 4.9.

Remarks.—This well-marked species differs from the other Mexican members of the genus in having the soles of hind feet hairy posteriorly. It is also remarkable for the unusual width and rich coloration of the lateral lines from cheeks to tail. The posterior tubercle on the sole of the hind foot is very small for so large a species.

For convenience *H. gaumeri* is here included in the *desmarestianus* group, but is a somewhat aberrant species, presenting characters which set it off from all the others. Specimens from the humid, heavily forested interior of east-central Campeche and the northeast coast of Quintana Roo are not appreciably different from those of the animal inhabiting the arid districts of Yucatan.

Specimens examined.—Total number 30, from localities as follows:

Yucatan: Chichen Itza (type locality), 7; Progreso, 1; Tunkas, 6.
Campeche: Apazote, 6; Campeche, 1.
Quintana Roo: La Vega, 5; Puerto Morelos, 4.

Subgenus XYLOMYS Merriam.

Type.—*Heteromys* (*Xylomys*) *nelsoni* Merriam, from Pinabete, Chiapas, Mexico.

Distribution.—Known only from Pinabete, Chiapas, Mexico.

Subgeneric characters.—Pelage composed of soft bristles intermixed with slender hairs; sole of hind foot naked, six-tuberculate; inner sides of forearms dusky. Braincase high and rounded; temporal ridges faint; upper surface of maxillary root of zygoma large and irregularly rectangular; parietals prolonged laterally along lambdoid crest, reaching or nearly reaching mastoids, thus more or less completely separating squamosal from supraoccipital; angle of mandible very slightly everted. Molariform tooth rows very broad posteriorly, the last molars equal to or broader than premolars; posterior prism of last upper molar and anterior prism of lower premolar with two transverse loops, confluent near middle, and usually uniting through wear at inner or outer ends; last lower molar with a distinct pit at postero-external base; lower incisor without trace of tubercle over root.

Remarks.—The subgenus *Xylomys* is represented by a single known species, possibly a survivor of an earlier group with more complicated dentition. *Xylomys* departs from the subgenus *Heteromys* mainly in the greater posterior width of molariform tooth rows, the weakly developed root of lower incisor, the more numerous and intricate enamel folds in crowns of posterior upper molars, and the lateral extension of parietals along lambdoid crest to mastoids. It differs also in the softness of its pelage, which in the adult state resembles the condition usual in the genus during adolescence.

HETEROMYS NELSONI Merriam.

NELSON SPINY POCKET MOUSE.

(Pl. I, figs. 2, 2*a*, 2*b*, 2*c*, 2*d*.)

Heteromys (*Xylomys*) *nelsoni* Merriam, Proc. Biol. Soc. Wash., XV, pp. 43–44, Mar. 5, 1902.

Type locality.—Pinabete, Chiapas, Mexico (altitude 8,200 feet). Type No. 77920, ♂ adult, United States National Museum (Biological Survey collection), collected by Nelson and Goldman, February 11, 1896.

Distribution.—Humid, heavily forested Pacific slopes of Sierra Madre in southern Chiapas, Mexico, and doubtless adjacent portions of Guatemala

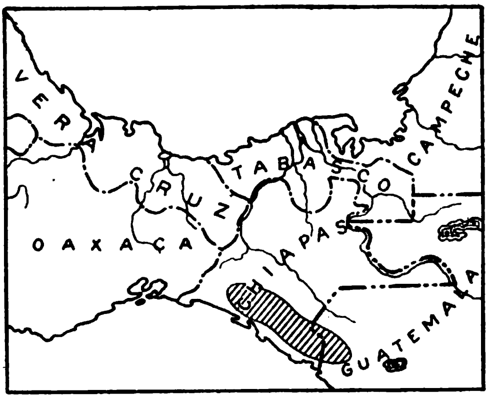

FIG. 3.—Distribution of *Heteromys* (*Xylomys*) *nelsoni.*

General characters.—Size very large, exceeding that of *H. goldmani;* tail much longer than head and body, thinly haired; and as in subgenus *Heteromys,* ears rather large, nearly naked, dusky and without distinct white edging; pelage soft; general color mouse gray; lateral line absent; sole of hind foot naked, six-tuberculate.

Color.—*Fresh pelage:* General color above mouse gray, becoming blackish along median line from nose to base of tail; forefeet and underparts, including lips and cheek pouches, white; outer sides of fore limbs to feet mouse gray, this color extending all round forearms except a narrow line along underside; hind feet white, faintly clouded along upper side to toes; ears, heels, and inner sides of ankles dusky; tail dusky above, whitish below except tip, which is dark all round.

Cranial characters.—Skull long and narrow; rostrum long, not tapering anteriorly, slightly constricted in front of zygomata; braincase high and rather smoothly rounded; supraorbital and temporal ridges faint; zygomata widest anteriorly, the upper surface of maxillary root large and somewhat rectangular; nasals very broad anteriorly, narrowing gradually posteriorly, the ends slightly emarginate; premaxillæ narrowing gradually, conterminous posteriorly with nasals; frontals elongated along median line, crowding nasals and premaxillæ far forward, but not prolonged along intermaxillary suture; interparietal small and oval; palate narrow between tooth rows; palatopterygoids slender; basioccipital narrow; audital bullæ, including meatus, large and inflated; dentition heavy.

Measurements.—Type: Total length, 356; tail vertebræ, 195; hind foot, 43.5. *Skull* (of same): Greatest length, 41.1; zygomatic breadth, 18; interorbital breadth, 9.3; length of nasals, 16.3; width of braincase, 15.8; alveolar length of upper molar series, 6.2.

Remarks.—*H. nelsoni* is the largest species of the genus known to occur in Mexico. It differs too widely from all the others to require close comparison with any of them. Externally it may be readily known by the remarkable softness of the pelage.

Specimens examined:

Chiapas: Pinabete (type locality), 2.

Genus LIOMYS Merriam.

Type.—*Heteromys alleni* Coues, from Rio Verde, San Luis Potosi, Mexico.
Liomys Merriam, Proc. Biol. Soc. Wash., XV, p. 44, Mar. 5, 1902.
Liomys Elliot, Mamm. Middle Amer. and W. Indies. Field Columb. Mus. Pub., Zool. Ser., IV, Pt. I, p. 374, 1904 (subgenus).

Distribution.—Tropical and Sonoran Zones from southern Texas and Sonora to Panama.

Generic characters.—Similar in general to *Heteromys;* pelage hispid; tail usually well haired; sole of hind foot hairy posteriorly (except possibly in *adspersus*), five- or six-tuberculate; inner sides of forearms pure white. Skull usually broad, with narrow rostrum; interpterygoid fossa U-shaped, broad and rounded anteriorly; angle of mandible strongly everted. Last molars decidedly narrower than premolars; tubercle over root of lower incisior large; posterior loop in crown of upper premolar with anterior border concave or slightly notched, but without deep reentrant angle; loops of molar crowns normally without additional enamel islands even in young.

Remarks.—The genus *Liomys* includes a number of slightly differentiated forms, some of which inhabit the Sonoran zones on the tablelands of Mexico. It is characterized by simpler, heavier dentition than *Heteromys;* the additional enamel islands or small reentrant angles in the loops of molariform teeth, present at least in the young of *Heteromys* and *Xylomys*, are normally absent in *Liomys*. The genus is readily divisible into three well-marked but rather closely allied groups: the *irroratus* group with soles of hind feet five-tuberculate, confined mainly to the Sonoran zones; the *pictus* group, nearly related to the preceding, with remarkably rich coloration, soles of hind feet usually six-tuberculate but varying to five, restricted mainly to Tropical zones; and the slightly more divergent *crispus* group with plain coloration and ranging wholly within the Tropical zones. In dental characters the *crispus* group differs notably from both the others in that the obliteration of the transverse sulcus in the first upper molar is not accompanied by the formation of a central enamel island, to be removed in turn by prolonged wear of the molar crown. This difference is apparent only in young adult individuals in which the obliteration of the transverse sulcus is still in progress. The three groups seem to represent distinct assemblages of species and subspecies, as partly shown by the overlapping of the groups in geographic range.

LIOMYS PICTUS GROUP.

LIOMYS PICTUS (Thomas).

PAINTED SPINY POCKET MOUSE.

(Pl. III, figs. 1, 1*a*.)

Heteromys pictus Thomas, Ann. Mag. Nat. Hist., ser. 6, XII, pp. 233–234, Sept.,1893.
Heteromys hispidus Allen, Bull. Amer. Mus. Nat. Hist., IX, pp. 56–57, Mar. 15, 1897. Type from Compostela, Tepic, Mexico, No. $\frac{\text{[illegible]}}{6867}$. ♀ ad., Amer. Mus. Nat. Hist., collected by Dr. Audley C. Buller, Feb. 11, 1893.

Type locality.—Mineral San Sebastian, Jalisco, Mexico (altitude, 4,300 feet). Type, ♀, in British Museum, collected by Dr. Audley C. Buller, May 9, 1893.

Distribution.—Coastal plains and basal mountain slopes in western Jalisco and Colima and probably western Michoacan. Arid Tropical Zone.

General characters.—Size rather small; tail longer than head and body, sharply bicolor; color reddish; orange buffy lateral line broad and distinct; ears edged with whitish; sole of hind foot hairy posteriorly, six-tuberculate.

Color.—*Fresh pelage:* General color above grizzled reddish brown, the result of intermixed brownish or dark grayish bristles and orange buff hairs, the latter unusually abundant and conspicuous; lateral line rich orange buff, broad and distinct from cheeks to hind legs; underparts and feet white; outer sides of forelegs varying from grayish to orange buffy, the color continuous along a narrow line with general color of upperparts, or interrupted by a white area below lateral line; outer side of hind legs mouse gray; sides of ankles, and sometimes heels, dusky; ears dusky, narrowly edged with whitish; tail brownish above, white below.

Cranial characters.—Skull long and narrow, with weakly developed supraorbital ridges, large subtriangular interparietal, and posteriorly truncate nasals; premaxillæ reaching posteriorly well beyond nasals; angle of mandible short, heavy, and everted; coronoid process small. Compared with that of *plantinarensis* the skull is much larger, longer, relatively narrower, and less arched; braincase less inflated; premaxillæ longer, passing farther posteriorly beyond nasals; interparietal larger; nasals normally truncate instead of deeply emarginate posteriorly.

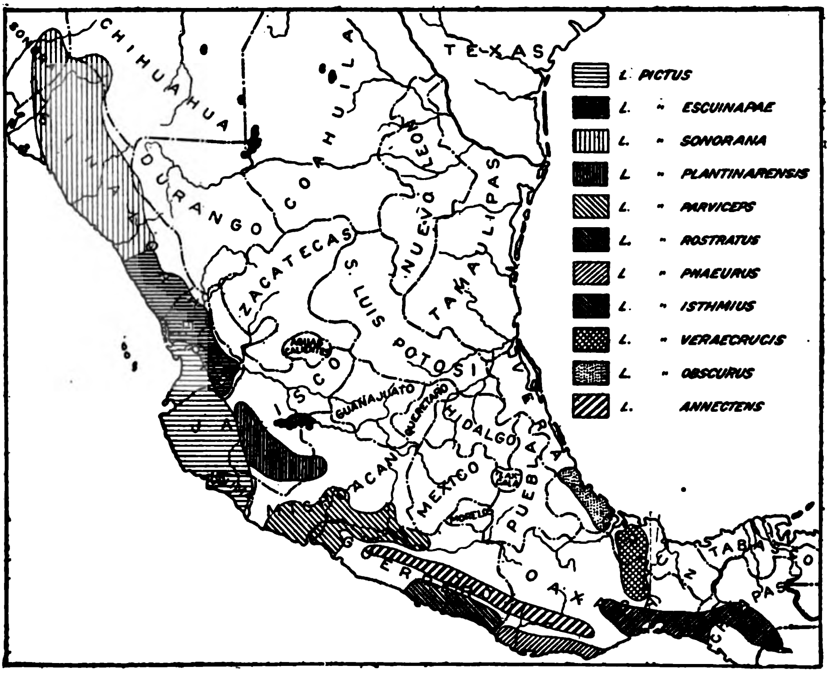

FIG. 4.—Distribution of *Liomys pictus* and allied forms.

Measurements.—Type (from original description): Head and body, 104; tail, 113; hind foot (without claw?), 24.8. Average of five adult topotypes: Total length, 251 (232–260); tail vertebræ, 136 (117–146); hind foot, 29.4 (27.5–31). *Skull* (average of same): Greatest length, 31.9 (30.9–33); zygomatic breadth, 14.3 (14.1–15); interorbital breadth, 7.5 (7.2–7.8); length of nasals, 13.3 (13.2–13.6); width of braincase, 13.8 (13.2–14); alveolar length of upper molar series, 4.9 (4.6–5).

Remarks.—*L. pictus* typifies a group of closely related forms characterized by rather small size, usually broad lateral line, and rich orange buffy coloration of slender dorsal hairs. The hind foot is usually six-tuberculate, but in some forms the number of tubercles may be either five or six. In Mexico the group is restricted in distribution to the tropical or subtropical coastal slopes from southern Sonora and central Vera Cruz to Guatemala.

Aside from its subspecies, *pictus* requires no close comparison with any known form. Near the coast of southern Tepic it intergrades with *escuinapæ*, and in the interior of western and southern Jalisco with *plantinarensis*. Specimens from the State of Colima vary considerably in size and have nasals more or less emarginate posteriorly, but agree otherwise with *pictus*.

H. hispidus of Allen seems inseparable from *pictus*. The type and a topotype agree in cranial characters with typical specimens of the latter form. The skins appear to have been immersed in alcohol, with the result that the blackish element in the pelage is somewhat faded and the reddish intensified.

Specimens examined.—Total number 90, from the following localities:

Jalisco: San Sebastian (type locality), 26; Arroyo de Plantinar, 6; Ixtapa, 5; Rio Santa Maria, 8; Sal si Puedes, 1; Wakenakili Mountains, 6.

Colima: Armeria, 11; Colima, 10; Hacienda Magdalena, 7; Hacienda San Antonio, 2.

Tepic: Compostela, 2; Navarete, 2; Santiago, 4.

LIOMYS PICTUS ESCUINAPÆ (Allen).

Escuinapa Spiny Pocket Mouse.

Heteromys pictus escuinapæ Allen, Bull. Amer. Mus. Nat. Hist., XXII, pp. 211–212, July 25, 1906.

Type locality.—Escuinapa, Sinaloa, Mexico. Type No. 24502, ♂ young adult, American Museum of Natural History, collected by J. H. Batty, February 3, 1904.

Distribution.—Coastal plains and Pacific slopes of Sierra Madre from southern Sinaloa southward, passing into typical *pictus* in southern Tepic and northwestern Jalisco. Arid Tropical and Lower Sonoran Zones.

General characters.—Closely related to *pictus*, but slightly grayer; nasals emarginate, instead of truncate, posteriorly; hind foot six-tuberculate as in *pictus*. Differing from *sonorana* in slightly darker, richer color and less deeply emarginate nasals.

Color.—About as in *pictus*, but slightly grayer, orange buffy hairs less numerous and conspicuous.

Cranial characters.—Skull similar to that of *pictus*, but shorter and relatively broader; nasals shorter and broader, emarginate instead of truncate posteriorly; premaxillæ less prolonged posteriorly beyond nasals; interparietal smaller. In general form similar to that of *sonorana*, but smaller; nasals less deeply emarginate posteriorly.

Measurements.—Type (from original description): Total length, 216; tail vertebræ, 108; hind foot (without claws), 24. Average of nine adult males: Total length, 223; tail vertebræ, 114.8; hind foot (without claws), 24.6. Average of eight adult females: Total length, 211.3; tail vertebræ, 109; hind foot (without claws), 23.4. *Skull* (average of six adults): Greatest length, 31 (29.9–31.9); zygomatic breadth, 14.6 (14.2–15.3); interorbital breadth, 7.7 (7.2–8); length of nasals, 12.8 (11.9–13.7); width of braincase, 13.8 (13.4–14.6); alveolar length of upper molar series, 4.9 (4.8–5).

Remarks.—This subspecies is intermediate in general characters and geographic position between *pictus* and *sonorana*, and specimens examined from numerous localities show complete intergradation with both. Specimens from the city of Tepic appear to be much closer to *escuinapæ* than to *pictus*, although the latter is nearly typical at Compostela, only a few miles away. Of a series of 10 skulls from Estancia, in northwestern Jalisco, two have the squarely truncate nasals of *pictus*, but are somewhat broader and in other respects agree with *escuinapæ*. Specimens from Culiacan, Sinaloa, and from Chacala, Durango, seem referable to *sonorana*, but in richer color and rather less deeply emarginate nasals indicate an approach to *escuinapæ*.

Specimens examined.—Total number 125, from the following localities:

Sinaloa: Escuinapa, 26 (including type); Mazatlan, 15; Plomosas, 11; Rosario, 6.
Jalisco: Estancia, 10.
Tepic: Acaponeta, 21; Amatlan, 9; Ojo de Agua (near Amatlan), 4; Pedro Pablo, 1; Rancho Palo Amarillo (near Amatlan), 13; Tepic, 9.

LIOMYS PICTUS SONORANA Merriam.

SONORA SPINY POCKET MOUSE.

Liomys sonorana Merriam, Proc. Biol. Soc. Wash., XV, p. 47, Mar. 5, 1902.

Type locality.—Alamos, Sonora, Mexico. Type No. 96252, ♂ adult, United States National Museum (Biological Survey collection), collected by E. A. Goldman, December 19, 1898.

Distribution.—Arid coastal plains and basal slopes of Sierra Madre from southern Sonora to southern Sinaloa. Mainly overlapping portions of Lower Sonoran and Arid Tropical Zones.

General characters.—Similar in size to *pictus* and *escuinapæ*, but color grayer, less tawny; lateral line narrower and paler; tail more hairy; skull with broad braincase and slender rostrum; hind foot six-tuberculate.

Color.—*Fresh pelage:* General color of upperparts pale mouse gray, coarsely grizzled with orange buffy hairs; underparts and feet white;

lateral line from cheeks to hind legs ochraceous buff; outer sides of forearms varying from pure white to very pale grayish buffy; ears edged with whitish; tail dusky above, whitish below on basal portion, darkening gradually toward tip, which is dusky all round.

Cranial characters.—Skull rather large and heavy, with broad braincase, narrow rostrum, small interparietal, and deeply emarginate nasals. Compared with *pictus*, the skull is broader and heavier; braincase larger; rostrum narrower, the sides more nearly parallel, broadening more abruptly at zygomata; maxillary root of zygoma heavier; nasals deeply emarginate instead of truncate posteriorly; interparietal smaller; dentition heavier. Differs from *escuinapæ* mainly in larger average size, heavier maxillary roots of zygomata, and more deeply emarginate nasals.

Measurements.—Type: Total length, 262; tail vertebræ, 142; hind foot, 32.5. Average of four adult topotypes: 243 (222–262); 129 (119–142); 30.9 (30–32.5). *Skull* (average of same): Greatest length, 33 (32.3–34.4); zygomatic breadth, 15.3 (15–15.5); interorbital breadth, 7.6 (7.2–7.9); length of nasals, 14.4 (13.3–15); width of braincase, 14.4 (14.3–14.4); alveolar length of upper molar series, 5.2 (5–5.5).

Remarks.—The range of *sonorana* marks the extreme northern limit of the genus. The most northern locality from which specimens are known is Camoa, on the Rio Mayo in Sonora, but the subspecies probably reaches at least a few miles farther north along the basal slopes of the Sierra Madre. From the northern part of its range *sonorana* changes progressively toward the south, assuming richer colors and presenting less extreme cranial characters, passing into *escuinapæ* in the region south of Mazatlan.

Specimens examined.—Total number 49, from the following localities:

Sonora: Alamos (type locality), 12; near Alamos, 2; Camoa, 4.
Chihuahua: Near Batopilas, 2.
Durango: Chacala, 10.
Sinaloa: Culiacan, 10; Sierra de Choix (50 miles northeast of Choix), 7; Sinaloa, 2.

LIOMYS PICTUS PLANTINARENSIS Merriam.

PLANTINAR SPINY POCKET MOUSE.

Liomys plantinarensis Merriam, Proc. Biol. Soc. Wash., XV, p. 46, Mar. 5, 1902.

Type locality.—Plantinar, Jalisco, Mexico. Type No. $\frac{33695}{46630}$, ♀ adult, United States National Museum (Biological Survey collection), collected by Nelson and Goldman, April 4, 1892.

Distribution.—Interior valleys and deep canyons along the western slopes of the plateau region in western and southern Jalisco and northwestern Michoacan. Mainly Arid Tropical Zone.

General characters.—Size very small; color reddish; orange buffy lateral lines usually broad and distinct; ears edged with whitish. Closely resembling *L. pictus* in color, but decidedly smaller, hind foot five- or six-tuberculate.

Color.—Fresh pelage: Upperparts grizzled reddish brown, resulting from intermixed dusky or grayish tipped bristles and orange buffy hairs, the general color darkest over median dorsal area; lateral line orange buff, extending from cheeks to hind legs; underparts and feet white; outer sides of forelegs pale grayish or orange buffy, the color in some specimens continuous above with lateral line, in others interrupted by a white area; outer sides of hind legs mouse gray; ears dusky, narrowly edged with whitish; tail brownish above, white below.

Cranial characters.—Skull similar in general to that of *pictus,* but smaller, shorter, relatively broader and higher arched; braincase more inflated; premaxillæ usually shorter, reaching only slightly beyond nasals posteriorly; interparietal shorter antero-posteriorly, with less developed anterior angle; nasals deeply emarginate instead of truncate posteriorly; dentition of the *pictus* type, but relatively heavier. Compared with that of *parviceps* the skull is larger, with braincase more arched and inflated; interparietal decidedly larger; rostrum more decurved.

Measurements.—Type: Total length, 202; tail vertebræ, 102; hind foot, 26. Average of five adults from Los Reyes, Michoacan: 219; 113; 26.5. *Skull* (type): Greatest length, 29.3; zygomatic breadth, 14; interorbital breadth, 7.4; length of nasals, 12.7; width of braincase, 13.4; alveolar length of upper molar series, 4.9.

Remarks.—This subspecies unites close external resemblance to *pictus* with smaller size and a different combination of cranial characters. Specimens from Ameca, Jalisco, have larger skulls than the type, with less deeply emarginate nasals and seem to be grading toward *pictus.* Those from Los Reyes, Michoacan, are darker in color, but in flatter braincase and small interparietal seem to show an approach to *parviceps.* The number of tubercles on the sole of the hind foot is very constant in most members of the genus, but varies from five to six in *plantinarensis* (five in the type).

Specimens examined.—Total number 19, from the following localities:

Jalisco: Plantinar, 1 (type); Ameca, 5.
Michoacan: Los Reyes, 13.

LIOMYS PICTUS PARVICEPS Goldman.

La Salada Spiny Pocket Mouse.

(Pl. III, figs. 2, 2*a*.)

Liomys parviceps Goldman, Proc. Biol. Soc. Wash., XVII, p. 82, Mar. 21, 1904.

Type locality.—La Salada, 40 miles south of Uruapan, Michoacan, Mexico. Type No. 126477, ♀ adult, United States National Museum (Biological Survey collection), collected by Nelson and Goldman, March 19, 1903.

Distribution.—Arid valley of the Balsas River in southern Michoacan and northern and extreme western Guerrero, Mexico. Arid Tropical Zone.

General characters.—Most like *plantinarensis* but less reddish; lateral line narrower or absent; outer sides of forearms usually pure white (grayish or buffy in *plantinarensis*); skull smaller; hind foot shorter, usually six-tuberculate.

Color.—Fresh pelage: Upperparts mouse gray, darkest on median dorsal area, thinly grizzled with orange buffy hairs; underparts and feet white; outer sides of forearms usually pure white, rarely tinged with pale grayish buff; lateral line, when present, orange buff, narrow and rather indistinct; ears edged with whitish; tail brownish above, white below.

Cranial characters.—Skull smallest of the known species of the genus. Resembling that of *plantinarensis*, but smaller and flatter; braincase less expanded; interparietal decidedly smaller; rostrum less decurved; nasals emarginate posteriorly, as in *plantinarensis*.

Measurements.—Type: Total length, 202; tail vertebræ, 110; hind foot, 24. Average of five adult topotypes: 204; 105; 24. *Skull* (average of five adults): Greatest length, 28 (26–28.3); zygomatic breadth, 13.1 (12.7–13.3); interorbital breadth, 6.6 (6.4–6.8); length of nasals, 11.2 (10.1–11.7); width of braincase, 12.6 (12.4–12.9); alveolar length of upper molar series, 4.4 (4.2–4.5).

Remarks.—The present form requires comparison only with *plantinarensis*. It is approached in cranial characters by specimens of the latter species from Los Reyes, Michoacan, and through *plantinarensis* probably intergrades with *pictus*. *Parviceps* appears to be restricted in distribution to the extremely arid region along the Balsas River and its tributaries. Six tubercles are usually present on the sole of the hind foot, but the smallest is clearly absent in a few specimens examined, and scarcely large enough to be perceptible in some others.

Specimens examined.—Total number 29, from the following localities:

Michoacan: La Salada (type locality), 12; La Huacana, 3.
Guerrero: El Limon, 9; Rio Balsas, 5.

LIOMYS PICTUS ROSTRATUS Merriam.

OMETEPEC SPINY POCKET MOUSE.

Liomys pictus rostratus Merriam, Proc. Biol. Soc. Wash., XV, p. 46, Mar. 5, 1902.

Type locality.—Near Ometepec, Guerrero, Mexico. Type No. 71488, ♂ adult, United States National Museum (Biological Survey collection), collected by Nelson and Goldman, February 14, 1895.

Distribution.—Arid coastal plains and basal mountain slopes in southeastern Guerrero, Mexico. Arid Tropical Zone.

General characters.—Similar in size to *pictus;* color similar; skull heavier, broader across maxillary roots of zygomata; interparietal more oval; hind foot six-tuberculate, as in *pictus*. Closely related to *phæurus*, but tail whitish below (dusky toward tip in *phæurus*); skull more massive; interparietal more oval.

Color.—As in *pictus*.

Cranial characters.—Skull similar in general to that of *pictus*, but more massive, broader across anterior roots of zygomata; maxillary branches of zygomata heavier and more widely spreading; nasals broader, truncate or emarginate posteriorly; interparietal more oval, with scarcely a trace of the anterior angle. From *phæurus* the skull differs in the same characters as from *pictus*.

Measurements.—Type: Total length, 252; tail vertebræ, 133; hind foot, 29. Average of five adult topotypes: 249 (235–262); 132 (120–145); 29.1 (28–30). *Skull* (average of five adults): Greatest length, 32.7 (31.7–33.5); zygomatic breadth, 15 (14.6–15.5); interorbital breadth, 7.8 (7–8.1); length of nasals, 13.7 (13.1–14.5); width of braincase, 14 (13.5–14.4); alveolar length of upper molar series, 4.8 (4.5–4.9).

Remarks.—In color *rostratus* agrees with *pictus*. The cranial characters, although rather well marked, indicate close relationship to both *pictus* and its nearer geographic neighbor *phæurus*. Specimens from Acapulco and Acahuizotla exhibit much individual variation and point to complete intergradation with *pictus* farther northward along the coast of Guerrero or Michoacan.

Specimens examined.—Total number 28, from localities as follows:

Guerrero: Near Ometepec (type locality), 10; Acapulco, 14; Acahuizotla, 4.

LIOMYS PICTUS PHÆURUS Merriam.

DUSKY-TAILED SPINY POCKET MOUSE.

Liomys phæura Merriam, Proc. Biol. Soc. Wash., XV, p. 48, Mar. 5, 1902.

Type locality.—Pinotepa, Oaxaca, Mexico. Type No. 71500, ♀ adult, United States National Museum (Biological Survey collection), collected by Nelson and Goldman, February 21, 1895.

Distribution.—Arid coastal region of southwestern Oaxaca. Arid Tropical Zone.

General characters.—Slightly smaller than *pictus;* color less reddish; orange buff lateral line narrower; tail dark all round on terminal half (whitish below in *pictus*); hind foot six-tuberculate. Closely related to *rostratus*, but smaller; tail dusky instead of white below on terminal half; interparietal triangular (oval in *rostratus*). Differing from *isthmius* mainly in darker tail, more conspicuous lateral line, and shorter, relatively broader, skull.

Color.—*Worn pelage:* General color of upperparts mouse gray, darkest on median dorsal area, thinly grizzled with orange buffy hairs; underparts and feet white; lateral line from cheeks to hind legs orange buff; outer sides of forearms edged with grayish; upper side of tail brownish, under side whitish at base and darkening gradually on terminal half.

Cranial characters.—Skull most like that of *pictus*, but shorter and relatively broader; frontals broader; interparietal smaller. Similar to that of *rostratus*, but smaller, shorter, and less massive; nasals much narrower; zygomata more squarely spreading, the maxillary roots weaker, with frontopremaxillary border less convex; braincase shorter. less projecting posteriorly over foramen magnum; interparietal more triangular, the anterior angle well developed and posterior border less convex; nasals usually emarginate, but sometimes truncate posteriorly. From *isthmius* the skull differs in about the same respects as from *pictus*.

Measurements.—Type: Total length (tail imperfect), 204; tail vertebræ (tip gone), 95; hind foot, 29. Average of three adults from Llano Grande, Oaxaca (near type locality): 230 (215–239); 115 (106–120); 29 (28.5–29.5). *Skull* (average of three adults): Greatest length, 31.5 (30.5–32.6); zygomatic breadth, 14.7 (14.6–15); length of nasals, 12.9 (12–14); width of braincase, 13.2 (12.1–14.5); alveolar length of upper molar series, 4.7 (4.4–5).

Remarks.—This form appears to be as closely related to typical *pictus* as to its nearer geographic neighbor *rostratus*. Specimens from Puerto Angel have less dusky tails than those from near the type locality and in cranial characters grade toward *isthmius*.

Specimens examined.—Total number 18, from localities as follows:

Oaxaca: Pinotepa (type locality), 2; Llano Grande, 7; Puerto Angel, 9.

LIOMYS PICTUS ISTHMIUS Merriam.

Isthmian Spiny Pocket Mouse.

Liomys pictus isthmius Merriam, Proc. Biol. Soc. Wash., XV, p. 46, Mar. 5, 1902.

Type locality.—Tehuantepec, Oaxaca, Mexico. Type No. 73367, ♂ adult, United States National Museum (Biological Survey collection), collected by Nelson and Goldman, April 28, 1895.

Distribution.—Arid coastal plains and interior valleys on the southern side of the Isthmus of Tehuantepec in southeastern Oaxaca and western Chiapas and thence eastward through the valley of the Chiapas River to Nenton, Guatemala. Arid Tropical Zone.

General characters.—Similar to *pictus*, but color paler, less reddish, the lateral line narrower or absent, and outer sides of fore limbs pure white instead of grayish or buffy; hind foot six-tuberculate, as in *pictus*. Closely related to *phæurus*, but tail whitish instead of dusky on terminal lower part, and skull larger and heavier. Differing from *veræcrucis* in paler color and less massive skull.

Color.—Fresh pelage: Upperparts mouse gray, grizzled with orange buffy; underparts, fore limbs, and hind feet white; lateral line, when present, orange buffy; tail brownish above, white below.

Cranial characters.—Skull closely resembling that of *pictus*, but rostrum more slender; premaxillæ less prolonged posteriorly beyond nasals; nasals emarginate instead of truncate posteriorly; interparietal slightly smaller. Similar to *veræcrucis*, but narrower and less massive; rostrum more slender; sagittal area narrower; lateral borders of frontals less deeply concave; zygomata less widely spreading. The skull differs from *phæurus* mainly in broader nasals and more oval interparietal.

Measurements.—Type: Total length, 245; tail vertebræ, 130; hind foot, 30. Average of five adult topotypes: 243 (226–257); 131 (121–140); 29.9 (29–30.5). *Skull* (average of five adults): Greatest length, 31.4 (30.4–32.2); zygomatic breadth, 14.5 (13.9–15.4); interorbital breadth, 7.7 (7.4–7.9); length of nasals, 13 (12.9–13.4); width of brain case, 13.7 (13.2–14.4); alveolar length of upper molar series, 4.6 (4.3–4.8).

Remarks.—In cranial characters *isthmius* is nearer *pictus* than to the geographically intervening forms through which they grade together. Specimens from Puerto Angel show intergradation with *phæurus*. Those from Santo Domingo and San Juan Guichicovi are intermediate, but nearer *veræcrucis*, which occupies the more humid area north of the range of *isthmius*. Many specimens from Tonala, Santa Efigenia, and the Chiapas Valley are darker and richer colored than topotypes, and those from the latter region usually have broader nasals, but these differences appear too slight to merit subspecific recognition.

Specimens examined.—Total number 85, from the following localities:

Oaxaca: Tehuantepec (type locality), 16; near Tehuantepec, 14; Chicapa, 1; Huilotepec, 3; San Bartolo, 3; Santa Efigenia, 14.

Chiapas: San Bartolome, 6; San Vicente, 1; Tonala, 6; Tuxtla Gutierrez, 14; Valley of Jiquipilas, 3.

Guatemala: Nenton, 4.

LIOMYS PICTUS VERÆCRUCIS Merriam.

VERA CRUZ SPINY POCKET MOUSE.

Liomys veræcrucis Merriam, Proc. Biol. Soc. Wash., XV, p. 47, Mar. 5, 1902.

Liomys orbitalis Merriam, Proc. Biol. Soc. Wash., XV, pp. 48–49, Mar. 5, 1902. Type from Catemaco, Vera Cruz, Mexico. No. 65452, ♀ ad., U. S. Nat. Mus. (Biological Survey collection), collected by Nelson and Goldman, Apr. 29, 1894.

Type locality.—San Andres Tuxtla, Vera Cruz, Mexico. Type No. 65457, ♀ adult, United States National Museum (Biological Survey collection), collected by Nelson and Goldman, May 7, 1894.

Distribution.—Humid northern slopes of the Isthmus of Tehuantepec, and coastal plains in southern Vera Cruz, Mexico. Humid Tropical Zone.

General characters.—Smaller than *pictus;* tail shorter; color darker, less tawny; lateral line much narrower; skull more massive; hind foot six-tuberculate, as in *pictus.* Intergrading with *obscurus* and *isthmius,* but differing from both in darker color and heavier skull.

Color.—*Fresh pelage:* General color of upperparts grizzled, dark reddish brown, the result of intermixed dark grayish or brownish bristles and orange buffy hairs (in worn pelage varying to blackish slate on median dorsal area); underparts and feet white; lateral line from cheeks to hind legs orange buffy, narrow, and in some specimens indistinct; outer sides of forelegs more or less distinctly grayish or buffy; hind legs mouse gray; ears edged with whitish; tail brownish above, white below.

Cranial characters.—Skull short and massive, with heavy rostrum and widely spreading zygomata. Compared with *pictus, isthmius,* and *obscurus,* the skull in general is relatively shorter, broader, and heavier; braincase more inflated; nasals usually shorter and broader, truncate or emarginate posteriorly; ascending branches of premaxillæ heavier, reaching posteriorly slightly beyond nasals; lateral borders of frontals more deeply concave; sagittal area broader; maxillary root of zygoma usually shorter and heavier than in *pictus* and *isthmius*—much heavier than in *obscurus;* interparietal about as in *isthmius,* but rather broad transversely.

Measurements.—Type: Total length, 220; tail vertebræ, 108; hind foot, 25. An adult topotype: 234; 116; 29. Average of three adults from Catemaco, Vera Cruz: 229 (225–234); 115 (109–122); 29 (28–29). *Skull* (average of three adults): Greatest length, 31.8 (31.4–32.2); zygomatic breadth, 15.6 (15.3–16); interorbital breadth, 7.8 (7.7–7.9); length of nasals, 13.2 (12.7–13.5); width of braincase, 14.5 (14.4–14.8); alveolar length of upper molar series, 4.8 (4.4–5.2).

Remarks.—This dark, strongly characterized form connects *isthmius* and *obscurus.* In some of the specimens from Santo Domingo and Guichicovi, Oaxaca, the skulls are more slender and show gradation toward *isthmius,* which inhabits the more arid area to the southward. Specimens from Otatitlan are nearest to *obscurus,* but show an approach to *veræcrucis* in dark edged forearms (pure white in *obscurus*) and the heavier maxillæ of some skulls.

"*L. orbitalis*" was based on a specimen with strongly developed skull from near the type locality of *veræcrucis.* Its characters appear to be within the range of individual variation in the subspecies *veræcrucis.*

Specimens examined.—Total number 34, from the following localities:

Vera Cruz: San Andres Tuxtla (type locality), 3; Catemaco, 8; Santiago Tuxtla, 1.

Oaxaca: Guichicovi, 7; Laguna, 1; Santo Domingo, 14.

LIOMYS PICTUS OBSCURUS Merriam.

CARRIZAL SPINY POCKET MOUSE.

Liomys obscurus Merriam, Proc. Biol. Soc. Wash., XV, p. 48, Mar. 5, 1902.

Heteromys paralius Elliot, Pub. Field Columb. Mus., Zool. ser., III, No. 13, p. 233, June, 1903. From San Carlos, Vera Cruz, Mexico. Type in Field Columbian Museum, collected by N. G. Buxton.

Type locality.—Carrizal, Vera Cruz, Mexico. Type No. 108563, ♀ adult, United States National Museum (Biological Survey collection), collected by Nelson and Goldman, May 12, 1901.

Distribution.—Arid coastal plains in south-central Vera Cruz, Mexico. Arid Tropical Zone.

General characters.—Size similar to *pictus*, but hind foot averaging slightly longer; color less tawny; lateral line narrower; maxillary root of zygoma weakly developed; hind foot six-tuberculate. Nearest geographically to and intergrading with *veræcrucis*, but differing in paler color and much less massive skull.

Color.—*Fresh pelage:* Upperparts mouse gray (varying in worn pelage to blackish slate), heavily grizzled with orange buffy; underparts, forelegs, and hind feet white; lateral line orange buffy, broad and distinct along cheeks and sides of neck, narrow and inconspicuous from shoulders to hind legs; tail dusky above, white below.

Cranial characters.—Skull similar in general to that of *pictus*, but nasals broader, more expanded anteriorly, emarginate posteriorly (truncate in *pictus*); sides of rostrum more nearly parallel, broadening more abruptly to zygomata. Most like *veræcrucis*, but less massive, narrower across anterior roots of zygomata; rostrum more slender, and sides more nearly parallel, broadening more abruptly posteriorly to zygomata; ascending branches of premaxillæ narrower; maxillary root of zygoma much less strongly developed.

Measurements.—Type: Total length, 238; tail vertebræ, 124; hind foot, 31. An adult topotype: 242; 128; 31. An adult from Santa Maria, Vera Cruz: 238; 117; 31. *Skull* (average of two adult topotypes): Greatest length, 32.1 (32–32.1); zygomatic breadth, 14.8 (14.4–15.3); interorbital breadth, 7.2 (7.1–7.4); length of nasals, 13.3 (13.2–13.4); width of braincase, 14 (13.9–14.1); alveolar length of upper molar series, 4.9.

Remarks.—The range of this subspecies marks the northern limit of the *pictus* group in eastern Mexico. In southern Vera Cruz it merges with that of *veræcrucis*. Specimens from Otatitlan are intermediate, but apparently nearer *obscurus*. They approach *veræcrucis* in general color, including the dark edging of forearms, but in cranial characters agree closely with *obscurus*.

The so-called *H. paralius*, from San Carlos, on the Gulf coast a few miles from the type locality of *obscurus*, appears to be based on typical specimens of the latter form.

Specimens examined.—Total number 11, from localities as follows:

Vera Cruz: Carrizal (type locality), 2; Otatitlan, 5; San Carlos, 1; Santa Maria, 3.

LIOMYS ANNECTENS (Merriam).

PLUMA SPINY POCKET MOUSE.

Heteromys annectens Merriam, Proc. Biol. Soc. Wash., XV, p. 43, Mar. 5, 1902.

Type locality.—Pluma, Oaxaca, Mexico. Type No. 71510, ♂ adult, United States National Museum (Biological Survey collection), collected by Nelson and Goldman, March 18, 1895.

Distribution.—Pacific slopes of Sierra Madre in Oaxaca and Guerrero, Mexico. Humid Tropical Zone.

General characters.—Size largest of the *pictus* group; orange buff lateral line conspicuous; sole of hind foot thinly haired posteriorly, six-tuberculate. Similar in general to *phæurus* and *rostratus*, but decidedly larger than either.

Color.—*Fresh pelage:* Upperparts dark mouse gray, the intermixed, slender, orange buffy hairs scarcely numerous enough to affect the general tone; lateral line from cheeks to outer sides of hind legs and along base of tail rich orange buff; underparts and feet pure white; ears dusky, sometimes faintly edged with whitish; tail dusky above, whitish below, becoming darker near tip.

Cranial characters.—Skull most like that of *phæurus*, but decidedly larger; rostrum relatively rather slender, usually broadening more abruptly posteriorly; interparietal subtriangular, the anterior angle well developed, as in *phæurus* (interparietal more oval in *rostratus*).

Measurements.—Type: Total length, 300; tail vertebræ, 165; hind foot, 33. Average of four adults from type locality: 281; 156; 32. *Skull* (average of two adult topotypes): Occipito-nasal length, 34.1 (34–34.2); zygomatic breadth, 16.3 (16.2–16.4); interorbital breadth, 8.2 (7.9–8.5); length of nasals, 14.7 (14.4–15.1); width of braincase, 14.4 (14.4–14.5); alveolar length of upper molar series, 5.2.

Remarks.—*L. annectens* is a member of the *pictus* group allied to *phæurus* and *rostratus*, but distinguished by larger size. It inhabits the humid, heavily forested upper slopes on the Pacific side of the Sierra Madre in Oaxaca and Guerrero; its geographic range parallels those of *rostratus* and *phæurus*, which lie along the more arid basal slopes of the mountains nearer the coast.

Specimens examined.—Total number 12, from the following localities:

Oaxaca: Pluma (type locality), 6.
Guerrero: Omilteme, 6.

LIOMYS CRISPUS GROUP.

LIOMYS CRISPUS Merriam.

TONALA SPINY POCKET MOUSE.

(Pl. III, figs. 3, 3*a*.)

Liomys crispus Merriam, Proc. Biol. Soc. Wash., XV, p. 49, Mar. 5, 1902.

Type locality.—Tonala, Chiapas, Mexico. Type No. 75105, ♂ adult, United States National Museum (Biological Survey collection), collected by Nelson and Goldman, August 7, 1895.

Distribution.—Coastal plains and lower foothills of the Sierra Madre in western Chiapas, Mexico. Arid Tropical Zone.

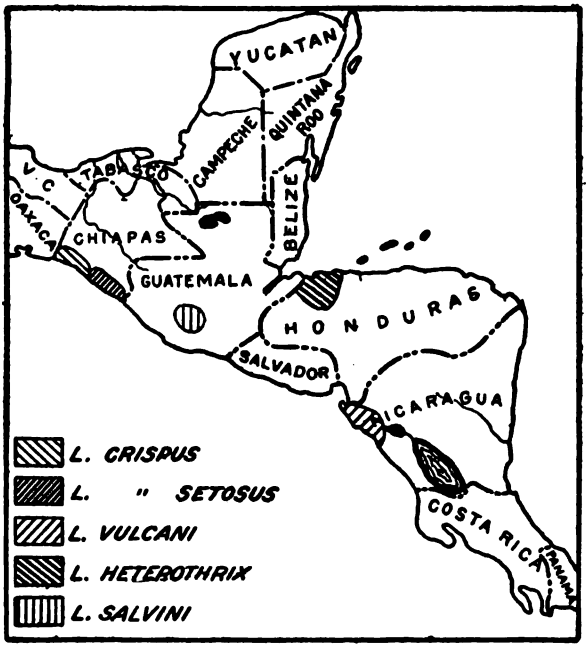

Fig. 5.—Distribution of *Liomys crispus* and allied forms.

General characters.—Size small; tail about equal to head and body, thinly haired, indistinctly bicolor; ears small; hind foot six-tuberculate, the sole hairy from heel to posterior tubercle; color brownish gray; ears not edged with whitish; lateral line absent; slender hairs over dorsal area standing out conspicuously beyond bristles.

Color.—*Fresh pelage:* Upperparts drab and hair brown, resulting from intermixed dusky tipped bristles and slender pale gray hairs, the general color darkest over median dorsal area; underparts, fore limbs, and hind feet creamy white; ears dusky; tail dusky above, becoming paler below, without sharp line of demarcation.

Cranial characters.—Skull small and slender; rostrum rather short; nasals not expanded anteriorly, the sides nearly parallel; ascending branches of premaxillæ slender, nearly conterminous posteriorly with nasals; supraorbital ridges weakly developed; interparietal irregularly oval, with very small posterior emargination; dentition much as in *L. pictus*, but crown of first upper molar more quadrate, never forming central enamel island by union through wear of ends of enamel loops; first upper molar with small inner and outer reentrant angles, due to closure of median sulcus, persisting until after formation of enamel islands in second and third molars (disappearing in *pictus*, at least on inner side, earlier in life).

Measurements.—Type: Total length, 210; tail vertebræ (tip gone), 99; hind foot, 27.5. Average of six adult topotypes: 216 (208–220); 108 (104–112); 26.7 (26–27). *Skull* (average of 4 adults): Greatest length, 31.5 (30.1–31.9); zygomatic breadth, 14.4 (14.1–14.8); interorbital breadth, 6.4 (6.3–6.7); length of nasals, 11.9 (11.4–12.5); width of braincase, 13.4 (13.1–13.7); alveolar length of upper molar series, 4.8 (4.5–4.9).

Remarks.—*Liomys crispus* with *setosus*, *heterothrix*, and probably *salvini* and *nigrescens*, comprise a group characterized by small size, short tail, and peculiar pelage and dental characters. Over the dorsal surface the slender hairs stand out much more conspicuously beyond the bristles than is usual in the genus. Owing to slight depth the transverse sulcus in the crown of the first upper molar disappears through wear without leaving a central enamel island, the loops uniting first near the inner side, as usual in the genus, but obliteration progressing more rapidly outward.

Specimens examined:

Chiapas: Tonala (type locality), 18.

LIOMYS CRISPUS SETOSUS Merriam.

Huehuetan Spiny Pocket Mouse.

Liomys crispus setosus Merriam, Proc. Biol. Soc. Wash., XV, p. 49, Mar. 5, 1902.

Type locality.—Huehuetan, Chiapas, Mexico. Type No. 77588, ♀ old adult, United States National Museum (Biological Survey collection), collected by Nelson and Goldman, February 22, 1896.

Distribution.—Forested coastal plains and basal slopes of Sierra Madre in southern Chiapas, Mexico. Humid Tropical Zone.

General characters.—Similar in size to *crispus*, but hind foot relatively longer; color decidedly darker; skull slightly larger.

Color.—*Partly worn pelage:* Upperparts grayish slate, darkest over median dorsal area; underparts, fore limbs, and hind feet creamy white; ears blackish; tail dusky above, dull whitish below.

Cranial characters.—Skull resembling that of *crispus*, but larger and heavier; nasals longer, the sides nearly parallel, as in *crispus;* premaxillæ reaching posteriorly well beyond nasals (nearly conterminous with nasals in *crispus*).

Measurements.—Type: Total length, 225; tail vertebræ, 110; hind foot, 29. Average of five adult topotypes: 213 (208–225); 104 (97–110); 28.8 (28–30). *Skull* (average of two adults): Greatest length, 32.2; zygomatic breadth, 14.9 (14.6–15.3); interorbital breadth, 6.9 (6.4–7.2); length of nasals, 12.8 (12.7–12.9); width of braincase, 14 (13.5–14.6); alveolar length of upper molar series, 4.8.

Remarks.—The darker color of this subspecies, compared with *crispus*, is probably due to the more humid, heavily forested character of the region it inhabits. The slender hairs among the bristles over dorsum are less numerous in the specimens examined than in *crispus*, but this may be a result of greater wear.

Mr. Gerrit S. Miller, jr., has compared for me topotype material of *setosus* with the type of *salvini*. His notes indicate rather close relationship, but the latter is "distinctly tawny," while the former shows no trace of this color.

Specimens examined:

Chiapas: Huehuetan (type locality), 14.

LIOMYS VULCANI (Allen).

VOLCAN SPINY POCKET MOUSE.

Heteromys vulcani Allen, Bull. Amer. Mus. Nat. Hist., XXIV, p. 652, Oct. 13, 1908.

Type locality.—Volcan de Chinandega (altitude about 4,000 feet), Nicaragua. Type No. 28315, ♀ adult, American Museum of Natural History, New York, collected by W. B. Richardson, May 7 (date of original tag), 1907.

Distribution.—Vicinity of the type locality in the mountains of extreme western Nicaragua.

General characters.—Closely allied to *L. c. setosus*, but smaller; color very similar, but slender hairs slightly more buffy; hind foot normally six-tuberculate, the sole thinly haired posteriorly; interparietal usually without the small posterior emargination present in *setosus*.

Color.—*Partly worn pelage:* Upperparts grayish slate, varying to blackish over median dorsal area, the slender hairs more buffy than in *setosus*, but scarcely altering the general color; underparts white; forelegs and hind feet usually nearly pure white (feet rather distinctly clouded with dusky in one specimen); ears blackish, faintly edged with whitish; tail dusky above, whitish below.

Cranial characters.—Skull closely resembling that of *setosus*, but decidedly smaller; ascending branches of premaxillæ reaching posteriorly beyond nasals as in *setosus* (not conterminous with nasals as in *crispus*); posterior border of interparietal more evenly convex as in *heterothrix* (usually without the small median emargination present in *setosus*); dentition as in the other members of the *crispus* group.

Measurements.—Type: Total length, 220; tail, 110; hind foot, 25 (collector's measurements in original description). *Skull* (type): Greatest length, 31; interorbital breadth, 6.9; length of nasals, 11.7; width of braincase, 13.4; alveolar length of upper molar series, 5. Average of two adult topotypes: Greatest length, 30.6; zygomatic breadth, 14.2; interorbital breadth, 6.9; length of nasals, 12.3; width of braincase, 13.4; alveolar length of upper molar series, 4.8.

Remarks.—*L. vulcani* is a member of the *crispus* group, closely allied to *setosus*. It may be not very unlike *salvini* and *nigrescens*, the types of which I have not seen. In some specimens of *vulcani* the forearms are pure white; in others a few inconspicuous dark hairs are scattered along the forearms. One specimen has the feet clouded with dusky, as already noted. The original description of *salvini* mentions "a narrow slaty-gray edging" of forearm which seems scarcely applicable to *vulcani*. The slender hairs protrude from among the bristles over dorsum as in *crispus* and are more buffy, but not the ochraceous buff which in *heterothrix* affects the general color. In cranial characters *vulcani* is nearer to *setosus* than to *heterothrix*. In one of the topotypes the interparietal is divided longitudinally by a suture, which is nearly continuous with the median suture between parietals.

Specimens examined:

Nicaragua: Volcan de Chinandega (type locality), 6.

LIOMYS HETEROTHRIX Merriam.

HONDURAS SPINY POCKET MOUSE.

Liomys heterothrix Merriam, Proc. Biol. Soc. Wash., XV, p. 50, Mar. 5, 1902.

Type locality.—San Pedro Sula, Honduras. Type No. 90161, ♂ adult, United States National Museum (Biological Survey collection), collected by J. C. Ingersoll, July 16, 1897.

Distribution.—Known only from the type locality, on the Chamelicon River, near the coast of northwestern Honduras.

General characters.—Size slightly larger than *L. c. setosus;* tail about equal to head and body, thinly haired, indistinctly bicolored; slender hairs tipped with ochraceous buff; forearms entirely white, without trace of "slaty-gray edging" of *H. salvini;*[1] ears faintly edged with whitish; hind foot six-tuberculate.

Color.—*Fresh pelage:* Upperparts between drab and hair brown, tinged with ochraceous buff by outstanding slender hairs; underparts, forelimbs, and feet creamy white; tail dusky above, paler below.

Cranial characters.—Skull similar in size and general form to that of *L. c. setosus*; nasals more wedge-shaped, tapering posteriorly; ascending branches of premaxillæ broader, reaching posteriorly beyond nasals, as in *setosus;* maxillary root of zygoma narrower and weaker, owing to greater anterior development of frontal along intermaxillary suture; interparietal more evenly oval, without small posterior emargination present in *setosus* and *crispus;* dentition as in *crispus*.

Measurements.—Type: Total length, 255; tail vertebræ, 126; hind foot, 31. Average of six adult topotypes: 227 (210–255); 110 (100–126); 27.5 (25–31). *Skull* (average of four adults): Greatest length,

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[1] See Thomas, Ann. Mag. Nat. Hist., ser. 6, XI, p. 331, 1893.

32.2 (29.9–34.7); zygomatic breadth, 14.8 (13.1–16.4); interorbital breadth, 6.9 (6.5–7.5); length of nasals, 13 (12–14); width of braincase, 13.7 (13.2–14.7); alveolar length of upper molar series, 4.8 (4.6–5).

Remarks.—The differences separating *heterothrix* from *crispus* and *setosus* are well marked, but its exact relationship to *salvini*, the type of which I have not personally examined, is somewhat problematical. The notes furnished by Mr. Gerrit S. Miller, jr., who has compared for me topotypes of both *heterothrix* and *setosus* with the type of *salvini*, seem to show that the latter is nearest to *setosus*, though differing rather decidedly in color, and in this respect approaching *heterothrix*.

Specimens examined:

Honduras: San Pedro Sula (type locality), 20.

LIOMYS SALVINI (Thomas).

SALVIN SPINY POCKET MOUSE.

Heteromys salvini Thomas, Ann. Mag. Nat. Hist., ser. 6, XI, pp. 331–332, 1893.

Type locality.—Dueñas, Guatemala. Type in the British Museum, collected by O. Salvin, July 31, 1873.

Distribution.—Vicinity of the type locality.

General characters.—Size small; general coloration rather dark. Similar to *L. c. setosus*, but upperparts tawny (slaty in *setosus*); outer side of forearm "with a narrow slaty-gray edging" (absent in *setosus*); hind foot shorter, the sole, as in *setosus*, hairy posteriorly and six-tuberculate.

Color.—From original description: "General colour blackish, rather darker than in most of the other species, grizzled with yellowish on the back. Lower surface pure white, as usual. Outer sides of forearm with a slaty-grey edging, more conspicuous than in *H. alleni* and *bulleri*, less than in *H. longicaudatus* * * * posterior half of sole [hind foot] covered with short brownish hairs * * *. Tail thinly haired, bicolor, but not so sharply and decidedly as usual, brown above, whitish below."

Cranial characters.—Skull apparently nearest to that of *L. c. setosus*, but slightly larger.

Measurements.—Type (from original description): Head and body, 115; tail (imperfect at tip), 95+?; hind foot, 26.5. *Skull* (type measured by Gerrit S. Miller, jr.): Greatest length, 33; zygomatic breadth, 15; interorbital breadth, 7; length of nasals, 13; alveolar length of upper molar series, 5.

Remarks.—Mr. Gerrit S. Miller, jr., has compared for me the type of *salvini* with topotypes of *setosus* and *heterothrix* and specimens of other small forms occurring in southern Mexico. His comparative notes seem to indicate nearest relationship to *setosus*, but he describes the back of the type of *salvini* as "distinctly tawny," of which color there is no trace in *setosus*. The skulls agreed very closely. The "slaty-gray" edged outer sides of forearms mentioned in the original description of *salvini* is another character not shared with *setosus* or *heterothrix*.

LIOMYS SALVINI NIGRESCENS (Thomas).

BLACK SPINY POCKET MOUSE.

Heteromys salvini nigrescens Thomas, Ann. Mag. Nat. Hist., ser. 6, XII, p. 234, 1893.

Type locality.—Costa Rica. Type in British Museum, No. 69. 7. 19.6.

General characters.—Size very small—still smaller than *salvini;* color darker; no yellowish lateral line.

Color.—From original description: "Colour very similar to that of *H. S. typicus,* but yellowish grizzling on the back, inconspicuous in that animal, is entirely absent, at least along the mesial line, so that the dorsal colour is a deep uniform smoky brown. Towards the sides a few yellow-tipped hairs are present, but not in sufficient numbers to affect the general tone. No trace of a yellowish lateral line. Limbs as in *H. S. typicus.*"

Cranial characters.—From original description: "Skull decidedly smaller and more delicate than in the typical form, the muzzle more slender, the interorbital region narrower, and the interparietal conspicuously smaller (its length-breadth percentage 51)."

Measurements.—Type: "Head and body, 127; tail broken; hind foot, without claws, 25." *Skull:* Greatest length, 32.7; zygomatic breadth, 15.2; interorbital breadth, 6.6; length of nasals, 13.2; alveolar length of upper molar series, 5.

Remarks.—This form, as nearly as can be determined from the original description and comparisons made for me by Mr. Miller, appears to belong with *salvini* to the *crispus* group. Comparing the skull of the type with *setosus* of the same group, Mr. Miller says: "Teeth and skull the same, but with audital bullæ slightly flatter and not quite as large. Interparietal slightly smaller, but of similar shape."

LIOMYS ADSPERSUS (Peters).

PANAMA SPINY POCKET MOUSE.

Heteromys adspersus Peters, Monatsber. K. Preuss. Akad. Wissensch., Berlin, pp. 356–359, with pl., May, 1874.

Type locality.—"Panama." Type, ♂ young (mounted), in Berlin Museum.

Distribution.—Range unknown.

General characters.—Size medium; upperparts dark bluish drab, or dark gray, slightly speckled with ochraceous buff; entire forelegs white; hind feet naked posteriorly, six-tuberculate.

Color.—General color of upperparts dark bluish drab, or dark gray, the back slightly speckled by ochraceous buffy hairs; underparts pure creamy white; feet and forelegs white, the drab of sides extending along outer surface of hind legs to heels; ears faintly edged with whitish; tail thinly haired, coarsely annulated, indistinctly bicolored, brownish above, white below.

Cranial characters.—From original description: Upper incisors darker anteriorly than the lower, which are narrower and brighter yellow; upper premolar with three enamel loops, the anterior longer and narrower, the posterior shorter and broader, and both diverging internally to admit between them the third and smallest, which is egg-shaped; first upper molar with a deep inner and a shallow outer reentrant angle; third upper molar with an enamel pattern similar to that of second, but posterior loop noticeably narrower than anterior. Rostrum narrow, the nasals and premaxillæ projecting, as in allied species, far over the incisors, and premaxillæ forming in front sharp vertical ridges. The small incisive foramina, lachrymals, and interorbital foramina closely resemble those of *Geomys.* The frontals form, as in *Mus*, sharp supraorbital ridges which are continued across the parietals and bound a plane surface, with the interparietal, twice as long as broad, attached posteriorly, while the temporal fossæ are deepened. The under jaw closely resembles that of *Perognathus* in the shape of the coronoid and angular processes; the deep fossa which in *Geomys* extends outward from the posterior molar is entirely absent.

Measurements.—Dry skin of type (from original description): Head and body, 145; tail, 95; hind foot, 30. *Skull:* No measurements available.

Remarks.—The type of *H. adspersus* Peters I have not examined, but Peters's full description and plate illustration of cranial and dental characters, together with notes kindly made for me by Mr. Gerrit S. Miller, jr., seem to indicate that the species belongs to the genus *Liomys,* but differs from all the other known members in having the soles of hind feet naked posteriorly. The dental characters shown by the plate are those of an immature individual with permanent premolars in place, but very slightly worn. The teeth in some respects approach those of *L. heterothrix* of similar age, and the two species may prove to be related. From *repens,* a spiny pocket mouse of the genus *Heteromys* inhabiting the same general region, *adspersus* may be known externally by the white instead of dusky outer sides of forelegs; and the skull differs notably in narrower, more constricted frontal region and in the apparent absence of additional enamel islands in the posterior lobes of all the upper molariform teeth.

LIOMYS IRRORATUS GROUP.

LIOMYS IRRORATUS (Gray).

OAXACA SPINY POCKET MOUSE.

(Pl. III, figs. 5, 5*a*.)

Heteromys irroratus Gray, Proc. Zool. Soc. Lond., p. 205, 1868.

Heteromys albolimbatus Gray, Proc. Zool. Soc. Lond., p. 205, 1868. From La Parada, Oaxaca, Mexico. Cotypes (2) in British Museum, probably collected by Boucard for Sallé.

Type locality.—State of Oaxaca, Mexico. Type in British Museum, probably collected by Boucard for Sallé near the city of Oaxaca.[1] Specimens from the city of Oaxaca are considered typical.

Distribution.—High interior plains and lower mountain slopes in central and eastern Oaxaca, Mexico. Lower Sonoran and Humid Tropical Zones.

General characters.—Size rather large; tail slightly longer than head and body, well haired, sharply bicolor; color grizzled gray; lateral line faint; ears distinctly edged with white; sole of hind foot hairy posteriorly, five-tuberculate.

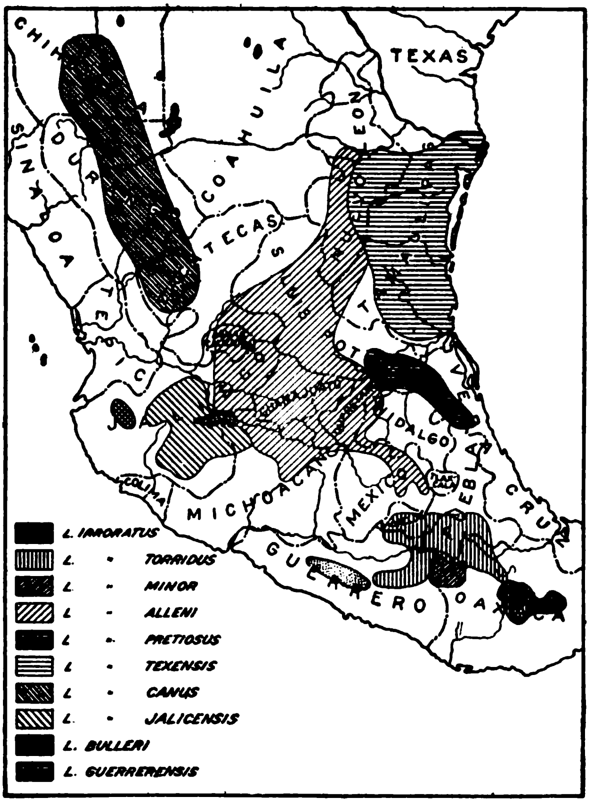

FIG. 6.—Distribution of *Liomys irroratus* and allied forms.

Color.—Fresh pelage: Upperparts mouse gray, darkest, and in some specimens more or less mixed with blackish on top of head and back, thinly grizzled with ochraceous buffy hairs; underparts and feet white; ochraceous buffy lateral line absent or usually inconspicuous;

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[1] For localities worked by Boucard in this region see Sclater, Proc. Zool. Soc. Lond., p. 295, 1858; ibid., 1859, pp. 369–370.

outer sides of forearms varying from nearly pure white to distinctly grayish; ears blackish edged with whitish; tail dusky above, whitish below, except tip, which is dark all round.

Cranial characters.—Skull large and rather heavy, relatively short and broad, with slender rostrum and widely spreading zygomata; supraorbital ridges rather weakly developed, as usual in the genus *Liomys;* sagittal area very wide; interparietal broadly oval; bullæ large and inflated; dentition heavy; anterior molars nearly as broad as premolars; posterior molars very small and cylindrical; tubercle over root of lower incisor well developed. Similar in general to that of *guerrerensis,* but less massive; rostrum much more slender; premaxillæ narrower; frontals narrower; maxillary root of zygoma less heavy. Compared with *bulleri,* the skull differs mainly in narrower frontal region and decidedly larger, broadly oval instead of triangular interparietal.

Measurements.—Average of six adults from Oaxaca, Oaxaca: Total length, 273 (258–295); tail vertebræ, 148 (132–163); hind foot, 32.3 (31–35). *Skull* (average of same): Greatest length, 33.2 (31.5–34.9); zygomatic breadth, 15.8 (15–17.1); interorbital breadth, 8 (7.7–8.3); length of nasals, 14.1 (13.2–14.9); width of braincase, 14.9 (14.3–15.6); alveolar length of upper molar series, 5.2 (4.9–5.5).

Remarks.—Specimens in the collection of the Biological Survey from various localities in Oaxaca have been compared for me by Mr. Gerrit S. Miller, jr., with the types of *irroratus* and *albolimbatus* in the British Museum. Those from the city of Oaxaca were found to agree closely with both, and in Mr. Miller's opinion *irroratus* and *albolimbatus* represent the same species. His comparative notes appear to justify this conclusion. Alston has shown[1] that the type of *albolimbatus* probably came to the British Museum through Sallé. Boucard made collections for Sallé at La Parada (type locality of *albolimbatus*), altitude about 7,000 feet, on a mountain slope 15 miles northeast of the city of Oaxaca; also at San Miguel de Peras, a few miles southwest of the same city. As no exact locality was given for the type of *irroratus* which was obtained through Sallé from the "State of Oaxaca," it seems probable that it also was collected by Boucard at the same place as *albolimbatus* or elsewhere in the vicinity of the city of Oaxaca.

L. irroratus is typical of a group, most of the members of which are closely related and range over nearly the whole of the Mexican tableland region. The group belongs mainly to the Sonoran Zones, but several representatives reach a short distance into the Arid and Humid Tropical Zones.

Specimens examined.—Total number 30, from localities as follows:

Oaxaca: Oaxaca, 22; Cerro San Felipe, 2; Mount Zempoaltepec, 5; Yalalag, 1.

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[1] Biol. Centrali-Amer., Mamm., p. 167, 1879–1882.

LIOMYS IRRORATUS TORRIDUS Merriam.

TORRID SPINY POCKET MOUSE.

Liomys torridus Merriam, Proc. Biol. Soc. Wash., XV, p. 45, Mar. 5, 1902.
Heteromys exiguus Elliot, Pub. Field Columb. Mus., Zool. ser., III, pp. 146–147, Feb., 1903. From Puente de Ixtla, Morelos, Mexico. Type in Field Columbian Museum.

Type locality.—Cuicatlan, Oaxaca, Mexico. Type No. 69645, ♀ adult, United States National Museum (Biological Survey collection), collected by Nelson and Goldman, October 14, 1894.

Distribution.—Arid interior plains and valleys, from northern Oaxaca and southern Puebla west through Morelos and eastern Guerrero to Chilpancingo. Arid Tropical and lower part of Lower Sonoran Zones.

General characters.—Closely allied to *irroratus* and *alleni*, but smaller; outer sides of forearms less grayish (usually pure white); hind foot five-tuberculate as in *irroratus*.

Color.—As in *irroratus*, except outer sides of forearms, which are pure white or faintly edged with grayish.

Cranial characters.—Skull closely resembles that of *irroratus*, but averages much smaller, with nasals less deeply emarginate (sometimes truncate) posteriorly. Differs from *alleni* mainly in decidedly smaller size and less squarely truncate nasals.

Measurements.—Type: Total length, 242; tail vertebræ, 134; hind foot, 28. Average of 10 adult topotypes: 242 (227–252); 139 (129–143); 28.1 (27–29). *Skull* (average of 10 adults): Greatest length, 30.7 (29.9–32.1); zygomatic breadth, 14.2 (14–14.8); interorbital breadth, 7.7 (7.4–8.2); length of nasals, 12.3 (11.9–12.8); width of braincase, 13.4 (12.9–14); alveolar length of upper molar series, 4.5 (4.3–4.9).

Remarks.—This small form is nearly related to *irroratus* and *alleni* and connects them geographically. Its fairly well-defined range includes lower, hotter areas than those of *irroratus* or *alleni*, but complete intergradation seems certain. Specimens of *irroratus* from the city of Oaxaca show a large amount of individual variation, and the smallest are only slightly larger than typical *torridus* and agree otherwise very closely with it. Those from higher parts of the plateau region in and near the Valley of Mexico are apparently nearest to *alleni*, but present variable characters and in some respects approach *torridus*.

Topotypes of *H. exiguus* Elliot are nearly typical *torridus*.

Specimens examined.—Total number 109, from the following localities:

Oaxaca: Cuicatlan (type locality), 37.
Guerrero: Ayusinapa, 1; Chilpancingo, 5; Tlapa, 5.
Morelos: Cuernavaca, 8; Puente de Ixtla, 4; Yautepec, 22.
Puebla: Acatlan, 2; Amolac, 2; Atlixco, 5; Piaxtla, 17; Tehuacan, 1.

LIOMYS IRRORATUS MINOR Merriam.

HUAJUAPAM SPINY POCKET MOUSE.

Liomys torridus minor Merriam, Proc. Biol. Soc. Wash., XV, p. 45, Mar. 5, 1902.

Type locality.—Huajuapam, Oaxaca, Mexico. Type No. 70301, ♀ adult, United States National Museum (Biological Survey collection), collected by Nelson and Goldman, November 18, 1894.

Distribution.—Elevated plains of northwestern Oaxaca and northeastern Guerrero, Mexico. Arid Tropical and Lower Sonoran Zones.

General characters.—Size smallest of the *irroratus* group. Most like *torridus*, but still smaller; hind foot five-tuberculate. Differs from *irroratus* in decidedly smaller size.

Color.—As in *torridus*.

Cranial characters.—Skull similar to that of *torridus*, but smaller; braincase more arched; rostrum heavier posteriorly, broadening more gradually to zygomata; nasals shorter, squarely truncate posteriorly.

Measurements.—Type: Total length, 222; tail vertebræ, 125; hind foot, 27. *Skull:* Greatest length, 29; zygomatic breadth, 14.2; interorbital breadth, 13; length of nasals, 11.7; width of braincase, 13.9; alveolar length of upper molar series, 4.6.

Remarks.—*L. i. minor* appears to be a rather localized form. Specimens from northeastern Guerrero seem to show intergradation with *torridus*.

Specimens examined.—Total number 7, from the following localities:

Oaxaca: Huajuapam (type locality), 4; Tlapancingo, 1.
Guerrero: Sochi, 1; Tlalixtaquilla, 1.

LIOMYS IRRORATUS ALLENI (Coues).

ALLEN SPINY POCKET MOUSE.

(Pl. I, figs. 3, 3*a*, 3*b*; Pl. III, figs. 4, 4*a*.)

Heteromys alleni Coues, Bull. Mus. Comp. Zool., VIII, pp. 187–189, 1881.

Type locality.—Rio Verde, San Luis Potosi, Mexico. Type No. 5889, ♂ adult, Museum of Comparative Zoology, collected by Dr. Edward Palmer, February 26, 1878.

Distribution.—Eastern and southern portions of Mexican tableland region from Monterey, Nuevo Leon, to the Valley of Mexico and as far west as Chicalote, Aguas Calientes, and Ocotlan, Jalisco. Upper and Lower Sonoran Zones.

General characters.—Similar to *irroratus*, but smaller; color and external appearance about the same; lateral line rather faint; tail relatively shorter, about equal to head and body; hind foot five-tuberculate. Similar to *pretiosus*, *jalicensis*, and *torridus*, but larger.

Closely related to *canus*, but smaller. Differs from *texensis* in larger size and grayer color.

Color.—As in *irroratus.*

Cranial characters.—Skull similar in general to that of *irroratus*, but nasals truncate instead of emarginate posteriorly; rostrum heavier; frontals broader; interparietal slightly smaller. Closely related to *jalicensis* and *torridus*, but larger, with more squarely truncate nasals. Similar to *texensis*, but larger, with relatively narrower frontals, and larger, broader, less evenly oval interparietal. Compared with *pretiosus* the skull is decidedly larger with rostrum less inflated anteriorly; premaxillæ less bulging over incisors; nasals relatively narrower anteriorly. Differs from *canus* mainly in smaller size and narrower frontals.

Measurements.—Average of two adult topotypes: Total length, 257; tail vertebræ, 137; hind foot, 32.7. Average of five adults from Ahualulco, San Luis Potosi: 254 (249–257); 126 (121–132); 31.6 (31–32). *Skull* (average of four adults): Greatest length, 34.5 (34–35.2); zygomatic breadth, 16.7 (16.1–17.1); interorbital breadth, 8.7 (8.5–9); length of nasals, 14.2 (13.9–14.6); width of braincase, 15.4 (14.9–15.8); alveolar length of upper molar series, 5.6 (5.3–6).

Remarks.—*L. i. alleni* is a widely distributed, central subspecies whose range is nearly or entirely surrounded by those of closely related forms. Specimens from Monterey, Nuevo Leon, agree with the typical form in color, and in breadth and shape of interparietal, but are smaller and apparently grading toward *texensis*. At lower elevations to the eastward of the type locality *alleni* passes into *pretiosus*, as shown by specimens of the latter form from Valles, San Luis Potosi, and from Jalpan, Queretaro. Specimens from Querendaro and Patzcuaro, Michoacan, and in and near the Valley of Mexico are variable and appear to be approaching *torridus*. On the west and northwest *alleni* intergrades with *jalicensis* and *canus*.

Specimens examined.—Total number 107, from the following localities:

San Luis Potosi: Rio Verde (type locality), 12; Ahualulco, 6; Hacienda la Parada, 3; Jesus Maria, 2; Villar, 15.
Aguas Calientes: Chicalote, 1.
Federal District: Tlalpam, 3.
Guanajuato: Acambaro, 1; Silao, 8.
Hidalgo: Marques, 2; Tula, 2; Zimapan, 3.
Jalisco: Ocotlan, 15.
Michoacan: Patzcuaro, 1; Querendaro, 5.
Nuevo Leon: Cerro de la Silla, 1; Monterey, 9.
Puebla: San Martin, 4.
Queretaro: Pinal de Amoles, 5; Tequisquiapan, 1.
Tamaulipas: Jaumave, 1; Miquihuana, 3.
Zacatecas: Berriozabel, 4.

LIOMYS IRRORATUS PRETIOSUS subsp. nov.

METLALTOYUCA SPINY POCKET MOUSE.

Type from Metlaltoyuca, Puebla, Mexico. No. 93097, ♂ adult, United States National Museum (Biological Survey collection), collected by E. A. Goldman, January 25, 1898. Original No. 12081.

Distribution.—Humid basal mountain slopes in extreme eastern San Luis Potosi, northern Queretaro, eastern Puebla, and northern Vera Cruz, Mexico. Humid Tropical Zone.

General characters.—Similar to *alleni*, but color slightly darker; lateral line more distinct; cranial characters pronounced; hind foot five-tuberculate. Somewhat like *texensis*, but much darker, ochraceous buffy hairs less conspicuous.

Color.—*Fresh pelage:* Upperparts dark mouse gray, mixed with blackish on median dorsal area, thinly grizzled with ochraceous buffy hairs; underparts and feet white; lateral line pale ochraceous buffy, usually distinct from cheeks to hind legs; outer sides of forelegs grayish, interrupted by buffy lateral line; tail dusky above, white below, except tip, which is dark all around.

Cranial characters.—Skull rather small, with short, anteriorly expanded rostrum and very narrow frontals. Similar in general to that of *alleni*, but decidedly smaller; anterior nares much more inflated; rostrum narrower posteriorly, the sides more nearly parallel; nasals relatively broader anteriorly, slightly emarginate posteriorly; frontals much narrower. Compared with *texensis* the skull is less massive; anterior nares more inflated; rostrum narrower posteriorly; frontal region much narrower, more constricted; premaxillæ reaching farther posteriorly beyond nasals; interparietal much broader transversely and less evenly oval.

Measurements.—Type: Total length, 263; tail vertebræ, 145; hind foot, 34. Average of five adult topotypes, 246 (239–263); 133 (127–145); 32.6 (31.5–34). *Skull* (type): Greatest length, 32.5; zygomatic breadth, 15.2; interorbital breadth, 7.5; length of nasals, 13.2; width of braincase, 14.6; alveolar length of upper molar series, 4.9.

Remarks.—In the remarkable inflation of the anterior nares *pretiosus* differs from all the other members of the *irroratus* group. The subspecies appears to be restricted in distribution to the Humid Tropical Zone. Specimens from Valles, San Luis Potosi, and from Jalpan, Queretaro, are nearer to *pretiosus*, but show gradation toward *alleni*, which occupies the higher, Sonoran areas of the table-land region to the westward.

Specimens examined.—Total number 25, from the following localities:

Puebla: Metlaltoyuca (type locality), 7.
Queretaro: Jalpan, 11.
San Luis Potosi: Valles, 3.
Vera Cruz: Papantla, 4.

LIOMYS IRRORATUS TEXENSIS Merriam.

TEXAS SPINY POCKET MOUSE.

Liomys texensis Merriam, Proc. Biol. Soc. Wash., XV, p. 45, Mar. 5, 1902.

Type locality.—Brownsville, Texas. Type No. 58670, ♀ adult, United States National Museum (Biological Survey collection), collected by J. Alden Loring, February 19, 1894.

Distribution.—Low plains from southern Texas to southern Tamaulipas, west in eastern Nuevo Leon to China. Lower Sonoran Zone.

General characters.—Most like *alleni*, but smaller and paler, the slender ochraceous buffy hairs more conspicuous; hind foot five-tuberculate. Similar in size to *pretiosus*, but much paler; differing also in well-marked cranial characters.

Color.—*Fresh pelage:* Upperparts pale mouse gray, darkest on top of head and back, rather conspicuously grizzled with ochraceous buffy hairs; underparts and feet white; lateral line pale ochraceous buffy, usually broad and distinct; outer sides of forearms grayish; tail dusky above, white below, except tip, which is dark all round.

Cranial characters.—Skull similar in general to that of *alleni*, but much smaller; frontals relatively broader; interparietal smaller, narrower, more evenly oval; nasals and premaxillæ more nearly conterminous posteriorly. Compared with *pretiosus* the skull is more massive; rostrum broadening more gradually to zygomata; frontals broader; interparietal much narrower transversely.

Measurements.—Type: Total length, 231; tail vertebræ, 114; hind foot, 30. Average of 10 adult topotypes: 237 (230–257); 122 (114–132); 29.2 (25–32). *Skull* (average of 10 adults): Greatest length, 31.8 (31.1–32.7); zygomatic breadth, 15.6 (14.9–16.4); interorbital breadth, 8.2 (7.8–8.8); length of nasals, 13 (12.2–13.6); width of braincase, 14.3 (13.9–14.8); alveolar length of upper molar series, 4.9 (4.5–5.2).

Remarks.—The range of *texensis* marks the northern limit of the genus along the Gulf coast. Although a well-marked form, it is evidently closely related to *alleni*, which inhabits the more elevated table-land region of the interior, and the two apparently intergrade in the vicinity of Monterey, Nuevo Leon.

Specimens examined.—Total number 91, from the following localities:

Texas: Brownsville (type locality), 42; Lomita Ranch, 4.
Nuevo Leon: China, 1; Montemorelos, 4.
Tamaulipas: Alta Mira, 7; Bagdad, 3; Hidalgo, 2; Matamoros, 18; Soto la Marina, 4; Victoria, 6.

LIOMYS IRRORATUS CANUS Merriam.

CHIHUAHUA SPINY POCKET MOUSE.

Liomys canus Merriam, Proc. Biol. Soc. Wash., XV, pp. 44–45, Mar. 5, 1902.

Type locality.—Near Parral, Chihuahua, Mexico. Type No. 96259, ♂ adult, United States National Museum (Biological Survey collection), collected by Nelson and Goldman, September 21, 1898.

Distribution.—High plains along the eastern base of the Sierra Madre from southern Chihuahua to southern Zacatecas. Upper and Lower Sonoran Zones.

General characters.—Size largest of the *irroratus* group. Most like *alleni*, but larger and slightly paler; lateral line less distinct; hind foot five-tuberculate. Similar to *jalicensis*, but much larger.

Color.—As in *irroratus* and *alleni*, but slightly paler, and lateral line less distinct.

Cranial characters.—Skull very similar to that of *alleni*, but larger, with broader frontals; nasals broader and heavier, truncate posteriorly as in *alleni*. Similar in general to *jalicensis*, but decidedly larger, nasals more squarely truncate posteriorly.

Measurements.—Type: Total length, 276; tail vertebræ, 138; hind foot, 34. Average of three adult topotypes: 262 (247–276); 133 (128–138); 33 (32–34). *Skull* (type): Greatest length, 36.9; zygomatic breadth, 18; interorbital breadth, 9.6; length of nasals, 15; width of braincase, 16.5; alveolar length of upper molar series, 5.5.

Remarks.—The large size of this form usually serves to separate it from *alleni*, to which it is evidently closely related. It appears to be restricted to a rather narrow high area along the east base of the Sierra Madre. Specimens from the city of Durango, Durango, and from San Juan Capistrano, Zacatecas, are smaller than the typical form, but agree in relative breadth of frontal region. Those from Valparaiso, Zacatecas, are nearly typical, although more distant from the type locality.

Specimens examined.—Total number 36, from the following localities.

Chihuahua: Near Parral (type locality), 8; Santa Rosalia, 1.
Durango: Durango, 1; Inde, 5.
Zacatecas: Hacienda San Juan Capistrano, 2; Valparaiso, 19.

LIOMYS IRRORATUS JALICENSIS (Allen).

JALISCO SPINY POCKET MOUSE.

Heteromys jalicensis Allen, Bull. Mus. Nat. Hist. XXII, pp. 251–252, July 25, 1906.

Type locality.—Las Canoas, about 20 miles west of Zapotlan, Jalisco, Mexico (altitude 7,000 feet). Type No. 26325, ♂ young adult, American Museum of Natural History, collected by J. H. Batty, August 6, 1905.

Distribution.—Table-land region of Jalisco and northwestern Michoacan. Mainly Lower Sonoran Zone.

General characters.—Most like *alleni*, but smaller; color the same; hind foot five-tuberculate. Similar to *canus*, but decidedly smaller and slightly darker.

Color.—As in *irroratus* and *alleni.*

Cranial characters.—Skull much like that of *alleni*, but smaller; nasals normally truncated posteriorly as in *alleni*. Differs from *canus* in decidedly smaller size and relatively narrower frontal region.

Measurements.—Type (from original description): Total length, 232; tail vertebræ, 112; hind foot (dry skin), 27.5. Average of three adults from Atemajac (near Guadalajara), Jalisco: 234 (228–238); 119 (117–124); 30 (30–31). *Skull* (average of 5 adult topotypes): Greatest length, 31.9 (31–32); zygomatic breadth, 15.3 (14.4–15.9); interorbital breadth, 8 (7.2–8.8); length of nasals, 12.3 (12–12.5); width of braincase, 14.5 (14.1–14.8); alveolar length of upper molar series, 5.1 (4.9–5.4).

Remarks.—This subspecies is evidently closely related to *alleni*, from which it appears to differ only in smaller size. The difference is constant in specimens examined from widely separated localities in the western part of the plateau region, including most of Jalisco and a part of Michoacan.

Specimens examined.—Total number 37, from the following localities:

Jalisco: Las Canoas (type locality), 10 (including type); Ameca, 9; Arroyo de Gavilan, 3; Atemajac, 8; Etzatlan, 1; Sierra Nevada, 1; Zapotlan, 2.
Michoacan: Zamora, 3.

LIOMYS BULLERI (Thomas).

BULLER SPINY POCKET MOUSE.

(Pl. III, figs. 6, 6*a*.)

Heteromys bulleri Thomas, Ann. Mag. Nat. Hist., ser. 6, XI, pp. 330–331, Apr., 1893.

Type locality.—La Laguna, Sierra de Juanacatlan, Jalisco, Mexico. Type (♀ adult in alcohol) in British Museum, collected by Dr. Audley C. Buller, December, 1892.

Distribution.—Known only from the type locality in the Sierra de Juanacatlan, Jalisco, Mexico. Upper Sonoran Zone.

General characters.—Size medium; tail slightly longer than head and body; color grayish; lateral line pale ochraceous buff; hind foot five-tuberculate. Size and color about as in *alleni;* cranial characters distinctive.

Color.—*Fresh pelage:* Upperparts mouse gray, mixed with blackish on median dorsal area, thinly grizzled with ochraceous buffy hairs; underparts and feet white; lateral line pale ochraceous buff, extending from cheeks to hind legs; outer sides of forelegs grayish, interrupted by a white area below lateral line; ears dusky, faintly edged with whitish; tail brownish above, white below.

Cranial characters.—Skull broad, flat, and rather short. Similar in general to that of *alleni*, but interparietal much smaller, subtriangular instead of oval, the anterior angle well developed; braincase less arched; nasals slightly broader posteriorly, concave instead of truncate. Differs from *jalicensis* in the same general characters as from *alleni*, in addition to larger size.

Measurements.—Type (from original description): Head and body, 114; tail, 120; hind foot (without claws), 28.5. An adult topotype: Total length, 250; tail vertebræ, 128; hind foot, 32. *Skull* (an adult topotype): Greatest length, 33.5; zygomatic breadth, 16; interorbital breadth, 8.6; length of nasals, 14.3; width of braincase, 14.8; alveolar length of upper molar series, 5.5.

Remarks.—A topotype of *bulleri* in the collection of the Biological Survey has been found by Mr. Gerrit S. Miller, jr., to agree very closely with the type in the British Museum. *L. bulleri* is clearly a member of the *irroratus* group. In external appearance it resembles *alleni* and *jalicensis*, but the cranial characters, especially the decidedly smaller size and more triangular shape of the interparietal, distinguish it from either.

Specimens examined:

Jalisco: La Laguna (type locality), 1.

LIOMYS GUERRERENSIS sp. nov.

GUERRERO SPINY POCKET MOUSE.

Type from Omilteme, Guerrero, Mexico. No. 127523, ♀ young, U. S. National Museum (Biological Survey collection), collected by Nelson and Goldman, May 17, 1903. Original No. 16435.

Distribution.—Humid heavily forested Pacific slopes of the Sierra Madre in the vicinity of the type locality. Humid Tropical Zone.

General characters.—Size large; tail about equal to head and body; color blackish; lateral line very faint; hind foot five-tuberculate. Similar in general to *irroratus*, but much darker, and cranial characters quite different.

Color.—Type (acquiring adult pelage): Top of head and back fresh deep glossy black, thinly grizzled with buffy hairs; sides of body and hind legs still in immature mouse gray pelage; underparts and feet white; outer sides of forelegs grayish, interrupted along lateral line; heels, inner sides of ankles, and hairy portion of sole of hind foot dark brownish black; ears black, edged with whitish; tail black above, white below, except extreme tip, which is dark all round.

Cranial characters.—Skull massive, short and broad, with short, heavy rostrum, broad frontal region, narrow palate, and heavy dentition. Compared with *irroratus*, the skull is heavier; rostrum shorter and much broader, especially posteriorly, broadening more gradually to zygomata; nasals shorter, slightly notched posteriorly; premaxillæ broader, reaching posteriorly beyond nasals; maxillary root of zygoma heavier; frontals broader; interparietal broadly pentagonal (oval in *irroratus*); palate narrower; dentition of the *irroratus* type, but heavier.

Measurements.—Type: Total length, 255; tail vertebræ, 127; hind foot, 34. An immature topotype: 247; 140; 35. *Skull* (average of two immature topotypes): Greatest length, 33.2 (33.2–33.3); zygomatic breadth, 16 (15.6–16.5); interorbital breadth, 8.5 (8.5–8.6); length of nasals, 13.1 (13–13.2); width of braincase, 15.4 (15–15.9); alveolar length of upper molar series, 5.8 (5.7–5.9).

Remarks.—*L. guerrerensis* is a member of the *irroratus* group, but appears to be a distinct species. The only known specimens are immature, but differ strikingly from *irroratus* of the same age, and the differences noted would doubtless be accentuated in adults. The unusually dark color of the species is probably due to a heavy forest environment.

Specimens examined:

Guerrero: Omilteme (type locality), 2.

PLATE I.

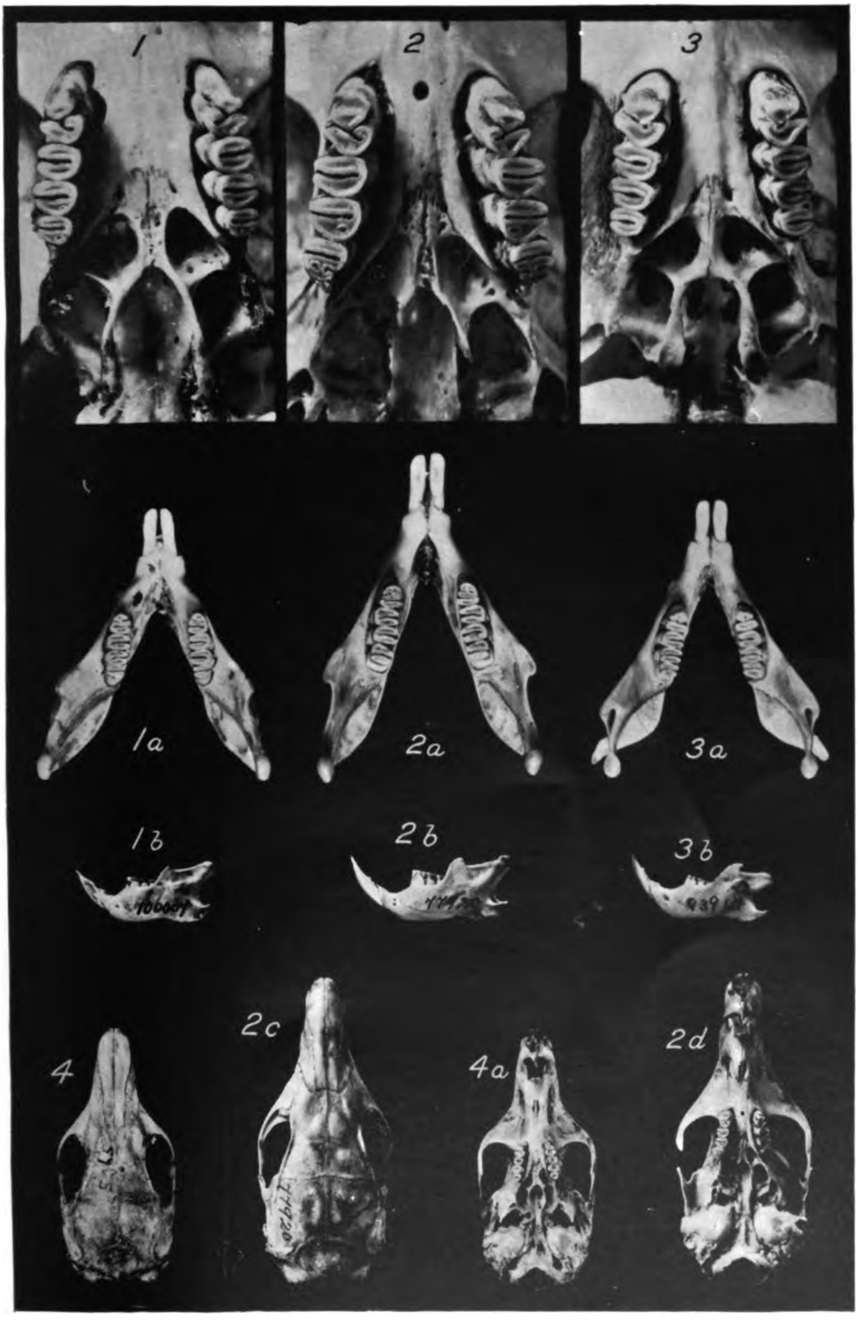
[Natural size, except figs. 1, 2, and 3, which are enlarged four diameters, and figs. 1*a*, 2*a*, and 3*a*, which are enlarged two diameters.]

FIGS. 1, 1*a*, 1*b*. *Heteromys* (*Heteromys*) *desmarestianus* Gray.
- 1. Partially worn crowns of upper molars. (No. 100007, U. S. Nat. Mus., Biological Survey Coll.)
- 1*a*. Jaw with partially worn molars. (No. 100007, U. S. Nat. Mus., Biological Survey Coll.)
- 1*b*. Lateral view of jaw. (No. 100007, U. S. Nat. Mus., Biological Survey Coll.)

2, 2*a*–2*d*. *Heteromys* (*Xylomys*) *nelsoni* Merriam.
- 2. Partially worn crowns of upper molars. (No. 77920, U. S. Nat. Mus., Biological Survey Coll.; type.)
- 2*a*. Jaw with partially worn molars. (No. 77920, U. S. Nat. Mus., Biological Survey Coll.; type.)
- 2*b*. Lateral view of jaw. (No. 77920, U. S. Nat. Mus., Biological Survey Coll.; type.)
- 2*c*. Upper view of skull. (No. 77920, U. S. Nat. Mus., Biological Survey Coll.; type.)
- 2*d*. Lower view of skull. (No. 77920, U. S. Nat. Mus., Biological Survey Coll.; type.)

3, 3*a*, 3*b*. *Liomys irroratus alleni* (Coues).
- 3. Partially worn crowns of upper molars. (No. 93914, U. S. Nat. Mus., Biological Survey Coll.)
- 3*a*. Jaw with partially worn molars. (No. 93914, U. S. Nat. Mus., Biological Survey Coll.)
- 3*b*. Lateral view of jaw. (No. 93914, U. S. Nat. Mus., Biological Survey Coll.)

4, 4*a*. *Heteromys* (*Heteromys*) *anomalus* (Thompson). Caura, Island of Trinidad. Adult male. (No. 5965, Amer. Mus. Nat. Hist.)



SKULLS AND JAWS OF HETEROMYS AND LIOMYS.

1, 1*a*, 1*b*. H. desmarestianus.
2, 2*a*, 2*b*, 2*c*, 2*d*. H. nelsoni.
3, 3*a*, 3*b*. L. i. alleni.
4, 4*a*. H. anomalus.

PLATE II.

[Natural size.]

Figs. 1, 1*a*. *Heteromys jesupi* Allen. Type. Near Minca, Colombia. Adult female. (No. 15347, Amer. Mus. Nat. Hist.)

2, 2*a*. *Heteromys australis* Thomas. Topotype. San Javier, Ecuador. Adult male. (No. 113306, U. S. Nat. Mus.)

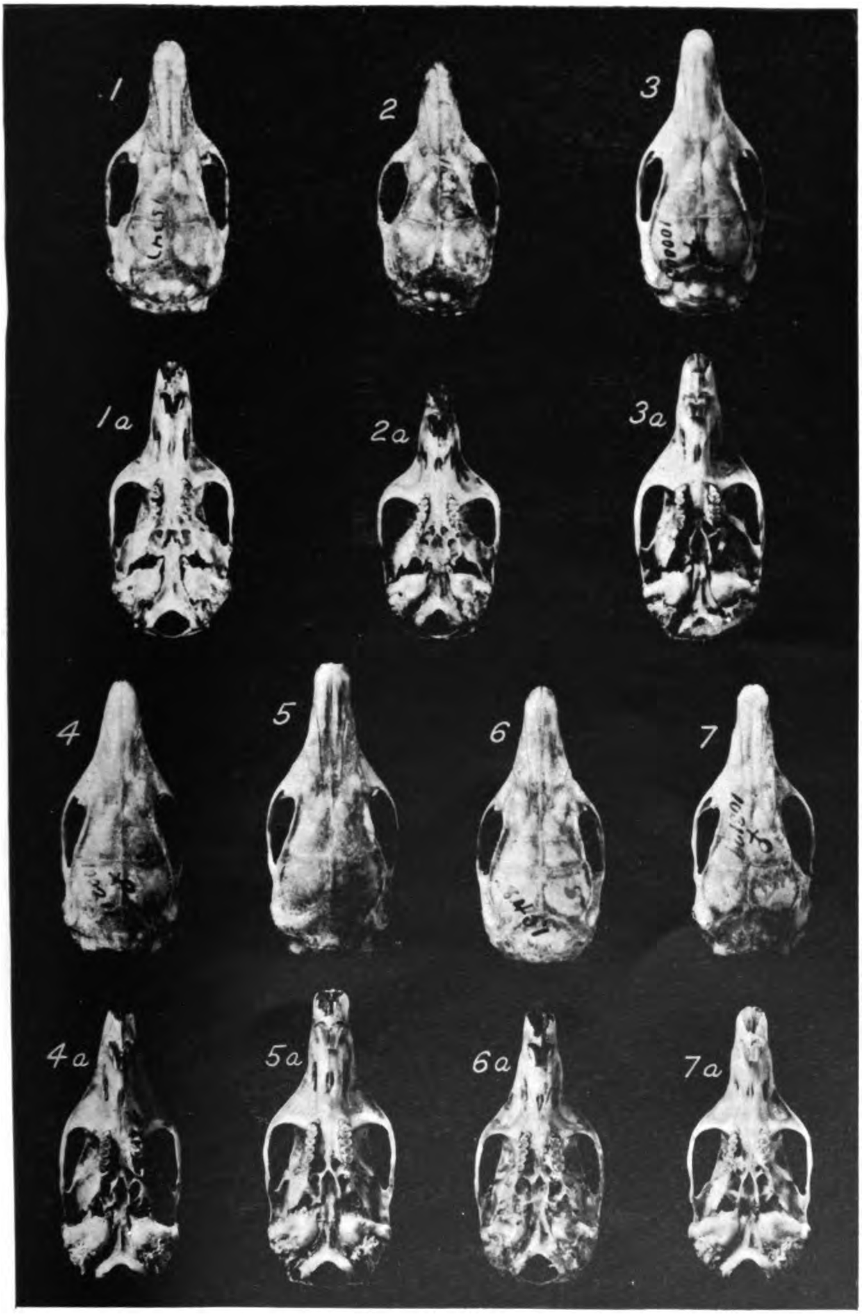
3, 3*a*. *Heteromys desmarestianus* Gray. Teapa, Tabasco, Mexico. Adult female. (No. 100003, U. S. Nat. Mus., Biological Survey Coll.)

4, 4*a*. *Heteromys longicaudatus* Gray. Montecristo, Tabasco, Mexico. Adult female. (No. 100211, U. S. Nat. Mus., Biological Survey Coll.)

5, 5*a*. *Heteromys goldmani* Merriam. Type. Chicharras, Chiapas, Mexico. Adult male. (No. 77576, U. S. Nat. Mus., Biological Survey Coll.)

6, 6*a*. *Heteromys fuscatus* Allen. Type. Tuma, Nicaragua. Adult male. (No. 28451, Amer. Mus. Nat. Hist.)

7, 7*a*. *Heteromys gaumeri* Allen and Chapman. Tunkas, Yucatan. Adult female. (No. 108129, U. S. Nat. Mus., Biological Survey Coll.)



SKULLS OF HETEROMYS.

1, 1a. H. jesupi.
2, 2a. H. australis.
3, 3a. H. desmarestianus.
4, 4a. H. longicaudatus.
5, 5a. H. goldmani.
6, 6a. H. fuscatus.
7. 7a. H. gaumeri.

PLATE III.

[Natural size.]

FIGS. 1, 1*a*. *Liomys pictus* (Thomas). Armeria, Colima, Mexico. Adult male. (No. 45371, U. S. Nat. Mus., Biological Survey Coll.)

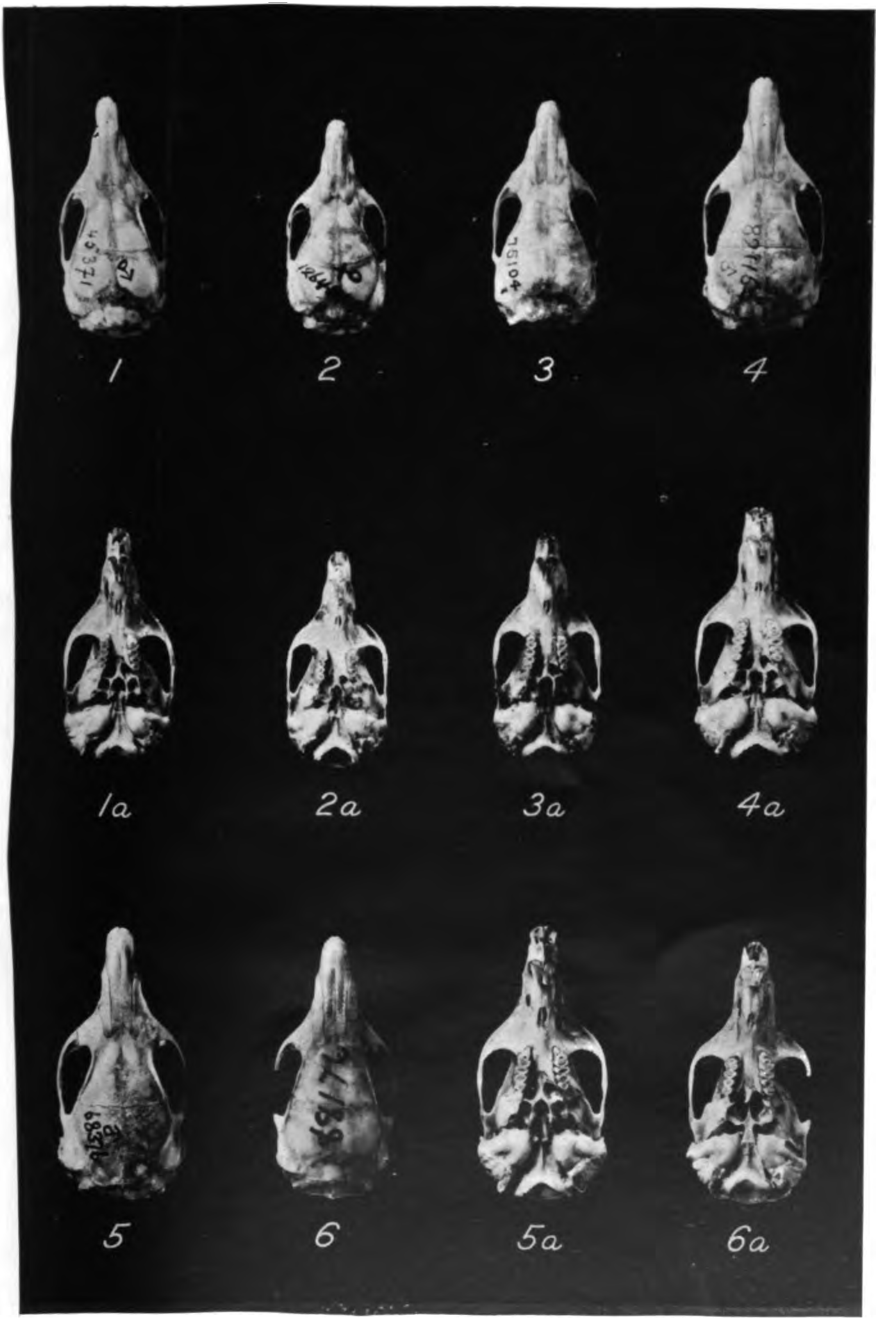
2, 2*a*. *Liomys pictus parviceps* Goldman. Topotype. La Salada, Michoacan, Mexico. Adult male. (No. 126481, U. S. Nat. Mus., Biological Survey Coll.)

3, 3*a*. *Liomys crispus* Merriam. Topotype. Tonala, Chiapas, Mexico. Adult male. (No. 75104, U. S. Nat. Mus., Biological Survey Coll.)

4, 4*a*. *Liomys irroratus alleni* (Coues). Topotype. Rio Verde, San Luis Potosi, Mexico. Adult male. (No. 82116, U. S. Nat. Mus., Biological Survey Coll.)

5, 5*a*. *Liomys irroratus* (Gray). Oaxaca, Oaxaca, Mexico. Adult male. (No. 68376, U. S. Nat. Mus., Biological Survey Coll.)

6, 6*a*. *Liomys bulleri* (Thomas). Topotype. La Laguna, Sierra de Juanacatlan, Jalisco, Mexico. Adult female. (No. 88176, U. S. Nat. Mus., Biological Survey Coll.)



SKULLS OF LIOMYS.

1, 1*a*. L. pictus.
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3, 3*a*. L. crispus.
4, 4*a*. L. i. alleni.
5, 5*a*. L. irroratus.
6, 6*a*. L. bulleri.

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HENRY W. HENSHAW, *Chief*

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LIFE ZONES AND CROP ZONES OF NEW MEXICO

BY

VERNON BAILEY

IN CHARGE OF BIOLOGICAL INVESTIGATIONS, BIOLOGICAL SURVEY

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Biological Survey,
Washington, D. C., March 15, 1913.

Sir: I have the honor to transmit herewith, for publication as North American Fauna No. 35, a report on the Life Zones and Crop Zones of New Mexico, by Vernon Bailey, in charge of Biological Investigations, Biological Survey. During recent years New Mexico has made rapid strides in modern agriculture, for which dry farming and irrigation projects are chiefly responsible. The present report is devoted mainly to a consideration of the life and crop zones of the State with a view to affording practical information as to the areas in which certain specified crops will best thrive. The accompanying map is intended to facilitate reference to the zones.

Respectfully,

Henry W. Henshaw,
Chief, Biological Survey.

Hon. David F. Houston,
Secretary of Agriculture.

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No. 35. NORTH AMERICAN FAUNA. Sept., 1913.

LIFE ZONES AND CROP ZONES OF NEW MEXICO.

By VERNON BAILEY.

INTRODUCTION.

The Biological Survey has carried on field work in every important valley and mountain range in New Mexico, and has gathered material for a fairly detailed map of the life zones of the State, which accompanies the present report, and for reports on the birds and mammals to be published later. The practical purpose of mapping life zones and their subdivisions is to show the extent and location of areas in the several States in which certain farm products thrive and outside of which they can not be made to thrive. In traversing the country even the most casual observer is often struck by the contrast in the plant and animal life of different regions. These differences sometimes conform to natural geographic areas, but upon close investigation are almost invariably found to correspond to changes of climatic conditions. By careful study of the distribution of native species of mammals, birds, reptiles, and plants,[1] which have reproduced for ages in their respective regions until they have become thoroughly adapted to them, it is possible to plot with considerable accuracy the areas which are marked by groups of species with similar ranges. In this way the climatic belts or life zones which cross the continent have been traced out and mapped with some detail. The temperature during the season of growth and reproduction controls the ranges of animals and plants, and therefore determines the extent and limits of the several zones.

While the climate may vary slightly in different parts of a distribution area, and always varies more or less in different years, the total range of variation does not exceed the power of adaptation possessed by the species living within the area. Beyond its borders, however, many or most of the species which characterize it give way to others that in turn have become adapted to their own climatic conditions. It should be remembered, however, that zone boundaries are never sharply marked in nature except on steep slopes, but change gradually as one set of average climatic conditions is succeeded by another. They are here mapped to conform as nearly as possible to the mean limits as indicated by the ranges of species of plants and animals.

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[1] Many species in other groups, notably of insects and mollusks, could be used to advantage in determining the limits of distribution areas, but unfortunately their ranges have not been mapped with sufficient accuracy for the purpose.

Not all distribution areas, however, are of equal rank. Some are so strongly characterized that comparatively few species overlap the boundaries, while others limit the ranges of a smaller percentage of species. Some are of great extent, while others are very restricted, and all are of irregular outline in conformity to the climatic barriers by which they are bounded. The broad and strongly marked life zones are made up of minor units, or subdivisions, some of which are so well marked as to have widely different crop adaptations. In New Mexico, however, the main life zones are comparatively uniform except the Upper Sonoran, in which the subdivisions are sufficiently well marked to show important differences in agricultural possibilities. In the other zones the crops that are found to flourish in one section can be safely introduced into other sections of the same zone without the necessity of slow and costly experimentation.

New Mexico, while rich in prehistoric ruins and containing some of the oldest Caucasian settlements in the United States, has only recently begun to make rapid strides in modern agriculture. "Dry farming" is now encroaching upon much of the best stock range, while irrigation is reclaiming many of the desert valleys. The Reclamation Service and private irrigation companies are building numerous reservoirs, canals, and ditches to conserve and utilize the water, and eventually much more of the desert will be brought under cultivation.

Stock raising, forestry, and mining are being put on a scientific basis. Graded cattle have almost entirely taken the place of the Texas longhorn; valuable horses are superseding the cayuse; the grade of sheep in many places is being greatly improved; lumbering is coming under Government control that, while utilizing the forests, will perpetuate them; and mining methods are being improved so that low-grade ores are worked at a profit.

Certain sections are becoming famous for the flavor and quality of fruits, which develop and mature to their greatest perfection under the combined influence of an arid atmosphere and the proper control of moisture in the soil. Various forage crops, grains, and vegetables have proved signally successful in restricted areas, and if the best results of a steadily developing agriculture are to be obtained the boundaries of the areas of approximately uniform agricultural character should be mapped and be made known.

Anyone familiar with the local flora and fauna can determine by reference to a list of the plants, birds, and mammals living in each zone the zonal position of any locality in New Mexico even without referring to the zone map, while the map will usually enable one not familiar with the native plants and animals to learn in which zone he resides. The map should also aid those desiring to take up any specific line of agriculture to locate where the conditions are most favorable.

GENERAL PHYSICAL FEATURES.

New Mexico is diversified by numerous mountain ranges, open plains, and extensive valleys. Its higher mountain ranges stand out in bold relief, usually belted or capped with dark forests, but there are also many half barren, jagged little peaks and ridges, rich in desert colors, quaint vegetation, and interesting forms of animal life, and often rich in minerals. The various mountain ranges are described in detail elsewhere in this report. But by far the greater part of its area is composed of grassy plains and arid valleys, lying between the levels of 4,000 and 7,000 feet. These also are described in some detail under their respective zones.

While some wide areas are approximately level and treeless, there are over most of the plains frequent canyons, gulches, "dry washes" (temporary watercourses), and occasional streams. The canyons, stream courses, and rough country generally are more or less wooded, and even the most arid valleys supply considerable fuel from their scrubby growth of mesquite with its greatly developed root system.

The lowest part of the State is in the south, where the Pecos River crosses the line at about 2,800 and the Rio Grande at about 3,700 feet, while the highest part is in the north, where Wheeler Peak reaches an altitude of 13,600 feet.[1]

This great range of altitude, together with an extent of nearly 6° of latitude, gives extremes of climate sufficient to include all of the life zones of North America above the Tropical and the lower division of Lower Sonoran, and to give a correspondingly wide range of agricultural possibilities.

The climate[2] of New Mexico is mainly arid, varying from semiarid on the eastern plains, with an average annual rainfall of 15 to 20 inches, to extreme arid in the western valleys, with an average annual rainfall generally given as varying from 10 to 15 inches. There are very few data as to the amount of precipitation in the mountains either in summer rains or winter snowfall, but to anyone who has been in the higher ranges at either season it is evident that they are far from arid. Summer rains are frequent; while in winter the snow often lies 6 to 10 feet deep in the woods and in summer rarely if ever entirely leaves the highest peaks. Thus the mountains feed the streams that water the valleys and while mainly above the zones of agriculture they are the real source of agricultural wealth. Not only the water but the rich alluvial soil of the valleys is brought down from the mountain slopes along the numerous watercourses.

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[1] Wheeler Peak is the highest point in the Taos Mountains, or the part of the Sangre de Cristo Range northeast of the Pueblo of Taos. Repeated aneroid readings from the railroad as a known base make it 13,600 feet, the highest peak in New Mexico.

[2] See Tinsley, T. D., Forty Years of New Mexico Climate, Bull. 59, New Mex. Agric. Exp. Sta., 1906.

Three important rivers (the Pecos, the Canadian, and the Gila) have their sources in the mountains of New Mexico, while the Rio Grande traverses its entire length and the San Juan makes a wide circuit through its northwestern corner. These with their branches supply far more water than is at present used, and enough when fully utilized to reclaim a large part of the desert. Still there are areas to which water can not be brought and which will long continue as open range. Much remains to be done in the improvement of grazing lands and the conversion of barren desert into productive grazing land. The resources of the State are now in various stages of development, some well advanced and others only beginning.

The best of these short-grass plains are in the eastern part of the State, where they comprise a wide area north of the Canadian River and nearly half of the Llano Estacado lying south of that river. These treeless, wind-swept plains, once a terror to travelers, are now dotted with ranches and windmills, marked by good roads and fences, and enlivened by countless herds of cattle. Between the Pecos and the Rio Grande lies another wide area of plains slightly more arid, while west of the Rio Grande are extensive but much broken and generally still more arid plains. These grassy plains furnish most of the range for vast numbers of stock produced in New Mexico, but much of the best stock range is now being used for "dry farming," and homes are being established in the semiarid regions, where there is no possibility of irrigation.

The principal valleys of the State are the Rio Grande, Pecos, and Gila in the south, the Canadian in the northeast, and the San Juan in the northwest. These, while comprising the hottest and most arid parts of the State, are of the greatest agricultural importance, as they contain extensive areas of rich alluvial soil and an ample supply of water for irrigating a large part of it.[1] The native vegetation of the lowest and hottest of these valleys is sparse and scattered, so that their value as stock range is comparatively slight, but under irrigation they are extremely productive.

PERSONNEL AND ACKNOWLEDGMENTS.

The field work on which the present report is mainly based was carried on by the author under the direction of Dr. C. Hart Merriam, with the assistance at different times of B. H. Dutcher, Arthur H. Howell, E. A. Goldman, N. Hollister, J. Alden Loring, James A. Gaut, E. A. Weller, and Clarence Birdseye. Additional field notes have been contributed by Dr. C. Hart Merriam, H. W. Henshaw, Dr. A. K. Fisher, and E. W. Nelson. Other assistance and information will be credited as far as possible under the separate notes. The various published local lists of birds, mammals, and plants have been of much assistance.

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[1] See Sullivan, Vernon L., Irrigation in New Mexico, Bull. 215, Office Exp. Sta., U. S. Dept. Agric., 1909.

For the identification of plants turned in to the United States National Herbarium, I am especially indebted to F. V. Coville, J. N. Rose, E. L. Greene, Paul C. Standley, and E. O. Wooton, and for specimens of trees turned in to the Forest Service, to George B. Sudworth. From both Prof. Wooton and Mr. Standley I have received much assistance in preparing the zone lists of plants, and the names of grasses, cactuses, and *Eriogonum* were supplied in large part by Prof. Wooton.

From Prof. Fabian Garcia, horticulturist of the New Mexico Agricultural Experiment Station, I have received many practical suggestions, and through the numerous publications of the experiment station, by Garcia and others, I have drawn freely on the fund of information collected by the various members of the staff.

LIFE ZONES AND CROP ZONES OF NEW MEXICO.

Six of the transcontinental life zones are represented in New Mexico (see frontispiece) as broad bands sweeping across the State, as tongues reaching in from farther south, or as encircling rings or caps on the elevated peaks and mountain ranges. *Lower Sonoran*, the zone of mesquite, comes into the southern valleys along the Pecos, Rio Grande, and Gila Rivers, and over the low plains of the southwestern corner of the State; *Upper Sonoran*, the zone of nut pine and juniper, covers most of the plains and foothill country; *Transition*, the zone of yellow pine, covers generally the middle mountain slopes of the high ranges; *Canadian*, the zone of spruce and fir, covers the higher mountain slopes; *Hudsonian*, the zone of dwarf spruces, occurs as a narrow belt of scrubby timberline trees around the high peaks; and the treeless *Arctic-Alpine Zone* caps many of the higher peaks in the Sangre de Cristo Range.

LOWER SONORAN ZONE.[1]

(*The zone of mesquite and creosote bush.*)

While only the upper or cooler part of this arid division of the Lower Austral Zone comes into southern New Mexico, it covers an area of approximately 18,000 square miles, some of which is of great agricultural value. It extends up the Pecos Valley to Roswell and in dilute form beyond; covers most of the Tularosa Valley; and extends up the Rio Grande Valley to Socorro and in narrow strips beyond; and west from the Rio Grande Valley in dilute form over the Deming Plains to the Upper Gila and San Francisco River Valleys. The Playas, Animas, and Hachita Valleys are also mainly Lower Sonoran. The zone has no important subdivisions in New Mexico and is as uniform in climate as in the assemblage of species which mark its boundaries. The greatest difference lies between its east and west extremes, the Pecos and Gila Valleys, each of which draws some of its species from adjoining areas—a few plains species entering the Pecos Valley and a few species extending up the Gila Valley from Arizona.

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[1] Lower and Upper Sonoran are here spoken of as zones, while they are in reality only the arid subdivisions of the Lower and Upper Austral Zones. The humid divisions of these, the Austroriparian and Carolinian, are not represented in New Mexico. For full classification and nomenclature of life zones of North America see Life Zones and Crop Zones of the United States, by C. Hart Merriam (Bull. 10, Biological Survey, 1898), and the Fourth Provisional Zone Map of North America, prepared by the Biological Survey, 1910.

It is the region of mesquite and creosote bush, striking shrubs which most conspicuously mark the zone, the mesquite marking a liberal and the creosote a more conservative boundary. Along the upper edge of the zone there is the usual overlapping of Upper and Lower Sonoran species, often resulting on gradual slopes in a complete mixture of the two zones for a considerable distance, but the dominant species at any point usually show to which zone that point really belongs.

The great advantages of the Lower Sonoran Zone for agricultural purposes are its high temperature and long growing period. Many crops mature that will not succeed in a cooler zone, and several successive crops are often raised on the same ground during one season. The abundance of water and the rich soil of its principal valleys make it, despite its limited area of arable land, the most important agricultural zone in the State. With the extension of irrigation its importance will be greatly increased, for at present agriculture is confined mainly to the lowest valley bottoms, which owing to the settling of cold air currents are more subject to spring and fall frosts than the adjoining bench lands. It is a well-known fact that frost often occurs on bottom lands when surrounding areas 50 or 100 feet higher escape, and these so-called "thermal belts" should be taken advantage of, especially in fruit raising.

The slight differences in the native species in each of the Lower Sonoran valleys may indicate slight variations in climatic or physiographic conditions, but there are also in each valley local conditions of soil and moisture that determine the limits of certain species, especially of plants. Most of these local peculiarities can be taken advantage of in some line of agriculture and all should be studied until thoroughly understood.

PECOS VALLEY.

This is the least arid of the Lower Sonoran valleys in New Mexico, and while characterized in the main by the same species which occur

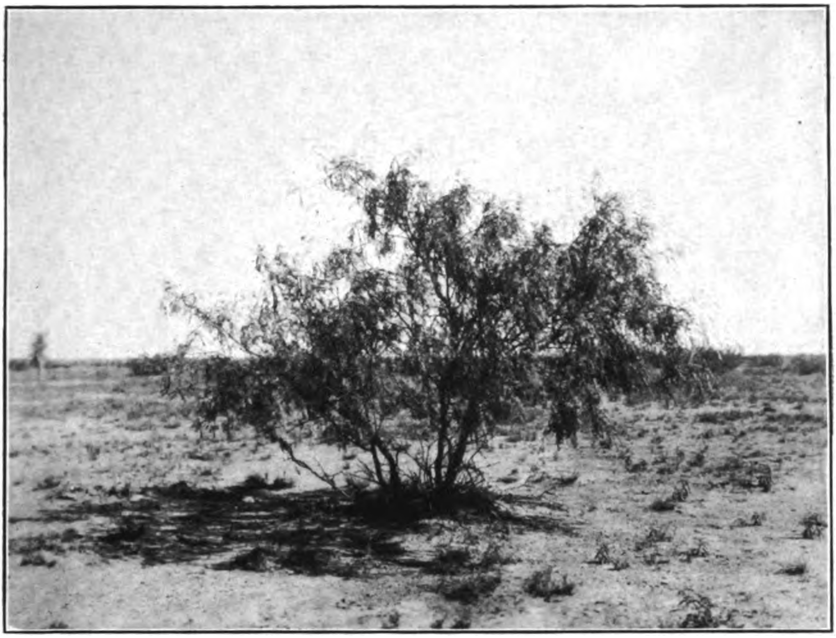

FIG. 1.—MESQUITE (PROSOPIS GLANDULOSA) IN LOWER SONORAN VALLEY WEST OF DEMING.

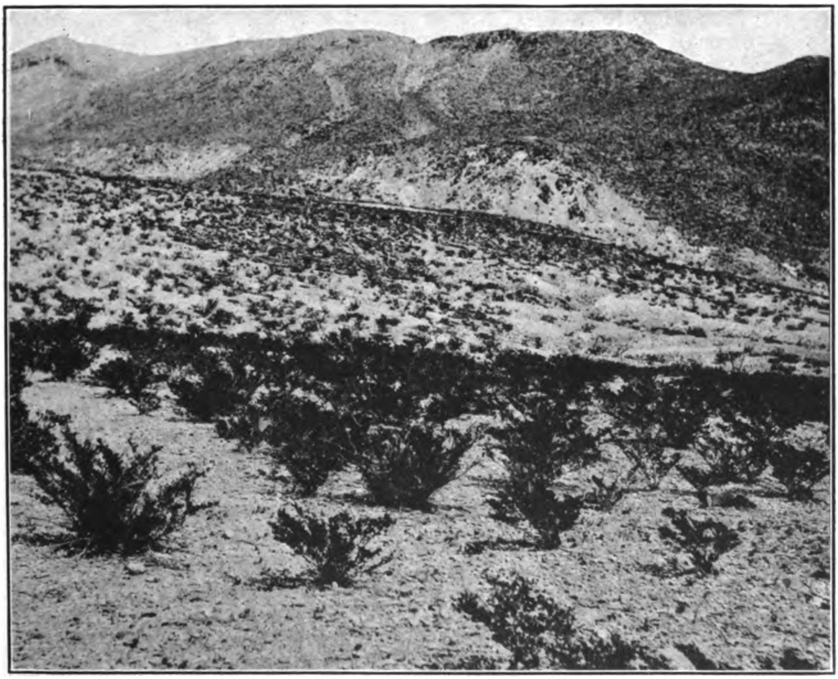

FIG. 2.—CREOSOTE BUSH (COVILLEA GLUTINOSA) ON LOWER SONORAN MESA ABOVE EL PASO.

in the others it has a more vigorous plant growth, better grazing on the uplands, and in places may allow some successful agriculture by "dry-farming" methods. The bottom lands and adjacent valley slopes which have received first attention in farm development are characterized by a vigorous growth of cottonwood, willows, baccharis, chrysothamnus, atriplex, dondia, heliotrope, salt grass, and other saline and alkaline plants, none of which are very strongly characteristic of the Lower Sonoran Zone. It is even questionable whether these cool bottoms should be classed as pure Lower Sonoran. The slightly elevated bench lands along the sides of the stream valleys, however, carry full sets of the most characteristic zone plants, mesquite, creosote bush, *Acacia constricta, Flourensia cernua,* allthorn (*Koeberlinia spinosa*), ocotillo (*Fouquieria splendens*), *Berberis trifoliolata,* sotol (*Dasylirion texanum*), lechuguilla (*Agave lechuguilla*), *Yucca macrocarpa,* and many others that definitely fix the zonal position of these parts of the valley.

In the Pecos Valley, as elsewhere near the border of a zone, these plants give place to Upper Sonoran species on north slopes or along cold bottoms, a fact that should be taken advantage of in diversified farming or horticulture. Until very recently little of the unmistakably Lower Sonoran area of this valley has been under cultivation, because it is easier to carry water over the lower levels. It seems a safe prediction, however, that the greater part of Pecos Valley will eventually be brought under cultivation through the extension of irrigation systems, the storage of flood and rain water along the side streams, and a partial use of dry-farming methods. Even the slopes that can never be irrigated can be greatly improved for grazing by a system of contour furrows that will catch and hold the rain where it falls. After a heavy rain in this valley the water is said to rise sometimes 50 feet in an hour in Pecos Canyon lower down, so quickly does it run off the open surface.

The Lower Sonoran Zone in the Pecos Valley, as indicated on the map (frontispiece) includes some mixed areas, especially along the edges and in the narrow northern strip extending along the river between Roswell and Santa Rosa, where only traces of the zone are found on hot slopes in the form of dwarf mesquite and occasional bushes of small-leaved sumac (*Schmaltzia microphylla*), *Zizyphus obtusifolia, Parosela formosa, Opuntia leptocaulis,* and *O. cyclodes,* together with some of the less closely restricted species of birds, mammals, and reptiles. So narrow a strip as this northern extension would hardly be indicated on the map except for its importance as a highway for the distribution of Lower Sonoran species between the Pecos and Canadian River Valleys through the narrow gap around the northern end of the Staked Plains, and the consequent intrusion of a dilute Lower Sonoran element in the New Mexico part of the Canadian River Valley north of Tucumcari.

CANADIAN RIVER VALLEY.

The Lower Sonoran element in the Canadian River Valley on warm slopes and open plains reaches from the Texas line up the valley above Tucumcari, with scattered traces across the low pass to Santa Rosa on the Pecos. It is marked by such characteristic species as mesquite, small-leaved sumac (*Schmaltzia microphylla*), soapberry tree (*Sapindus marginatus*), *Parosela formosa*, *Krameria secundiflora*, and *Opuntia leptocaulis*, and by the scaled quail, road-runner, Texas woodpecker, Scott's oriole, desert and Cassin's sparrows, and the western mockingbird.

While a great number of species in this valley are Upper Sonoran, the strong admixture of Lower Sonoran species indicates a modified climate, in which some Lower Sonoran crops would doubtless thrive.

TULAROSA VALLEY.

The great valley lying between the Sacramento and San Andres Mountain ranges is almost entirely Lower Sonoran, but so extremely arid and so unlikely to be adequately irrigated, unless from subterranean sources, that at present it is agriculturally unimportant. Over great stretches the land is level and the soil of excellent quality, but the few marginal streams barely reach the edges of the valley and furnish a very limited supply of water.

The striking features of the valley are its diminutive forests of tree-like yuccas (*Yucca radiosa*), its scattered growth of low desert shrubs and cactuses, its dunes of white gypsum sand, extensive playas with incrustations of salt and alkali, salt marshes, and wide flows or jagged outcroppings of black lava rock. In climate and in plant and animal life it is practically identical with the Rio Grande Valley above El Paso, with which it connects through low gaps in the mountain.

RIO GRANDE VALLEY.

The Rio Grande Valley from the Texas line north to Socorro is mainly Lower Sonoran, and traces of the zone extend north to Las Lunas and into the lower Puerco Valley. The lateral boundaries are more irregular than the zone map indicates, just as the details of valley surface and slope are more intricate than any map can show. In general, the Lower Sonoran Zone extends from the western foothills of the San Andres Mountains to the eastern base of the Mimbres and Magdalena Mountains and out to the southwest over the Deming plain. On east and west slopes the upper edge of this zone in the Rio Grande Valley conforms closely to the 5,000-foot contour, but on northeast slopes usually runs 500 feet lower and on southwest slopes 500 feet higher. On very steep slopes the variation is even greater, while on very gentle slopes it is proportionately less. Many low mountain ranges, high hills, or ridges stand out as Upper Sonoran islands in this area, while slopes dipping northward are generally Upper Sonoran down to about 4,500 feet.

The lowest part of the immediate river valley, where most of the farming has been carried on, is evidently not the warmest part of the Rio Grande Valley. While most of its vegetation is of Lower Sonoran species, such as mesquite, screw bean, acacia, atriplex, dondia, zizyphus, baccharis, pluchea, lycium, chilopsis, willows, and cottonwoods, some of these also run into or through the Upper Sonoran Zone. The side slopes of the valley are more purely Lower Sonoran, as shown by their flora and fauna. The characteristic plants of these middle slopes are mesquite, acacia, creosote bush, ocotillo (*Fouquieria splendens*), allthorn (*Koeberlinia spinosa*), small-leaved sumac (*Schmaltzia microphylla*), tree yuccas (*Yucca radiosa* and *Y. macrocarpa*), cactuses (*Echinocactus wislizeni, Opuntia leptocaulis*, and *O. engelmanni*), *Flourensia cernua, Coleosanthus laciniatus, Krameria canescens, Parosela frutescens, Ephedra trifurca*, and *Thamnosma texanum*.

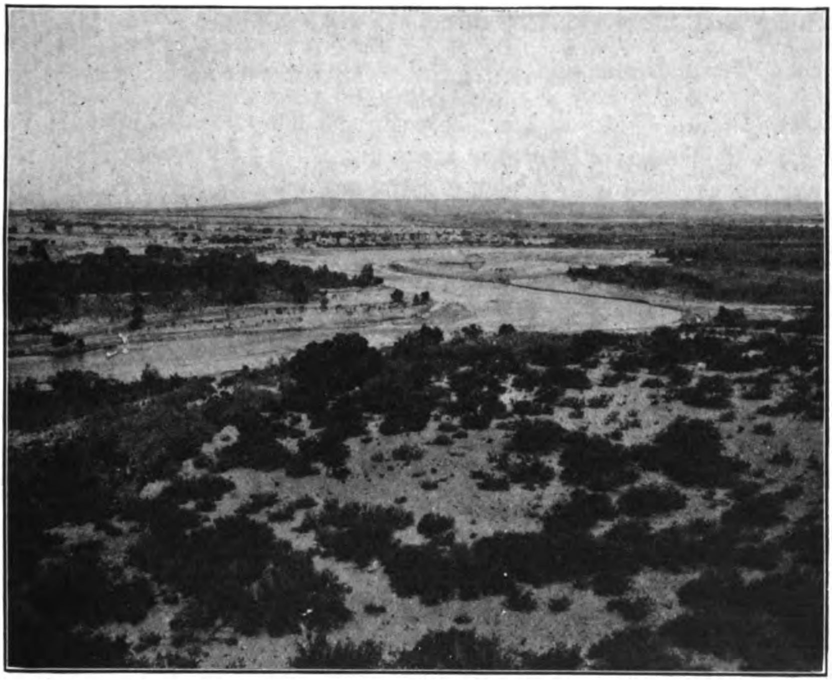

FIG. 1.—Rio Grande Valley at Las Palomas, below the Elephant Butte Reservoir.

The distribution of mammal, bird, and reptile life is less influenced than that of plant life by slight local changes of climate, but in determining the zones over the valley at large is of equal, if not greater, importance. The great advantage of plants is that they are always conspicuous, while the ranges of animals must be worked out slowly by collecting or identifying many individuals of each species

North over the great dry Jornada Valley,[1] which is part of the Rio Grande Valley, the general level rises to nearly 5,000 feet, and the long undulations alternate in Lower Sonoran Zone on south slopes and Upper Sonoran on north slopes. Such details can not be shown on a small scale zone map, but are counted as a part of the overlapping always found along the junction of two zones. Farther north, from San Marcial to Socorro, there is considerable overlapping, while north of Socorro are only scattered traces of Lower Sonoran species, some of which reach nearly to Albuquerque.

THE DEMING PLAIN.

The broad arid plain lying between the Rio Grande and Gila Valleys, with Deming as its center, is mainly below 4,500 feet. Numerous sharp and rugged little peaks, craters, and mountain ranges rise from its general level, and basin valleys drop a little below. The level plain is dominated by Lower Sonoran species, which run up to a little above 5,000 feet on warm slopes and down to about 4,500 feet on cold slopes. The Hachita, Playas, and San Luis Valleys form part of this Lower Sonoran plain, which opens out broadly to the valley of the Gila and other Lower Sonoran valleys of southern Arizona.

The plants and animals of these plains are mainly the same as in the Rio Grande Valley, with a few Arizona species coming in on the west. In fact, this plain is the great highway through which the Gila River Valley and Rio Grande Valley species characteristic of the upper division of the zone have freely intermingled. The lower or subtropical division of Lower Sonoran, as represented in the Rio Grande Valley of Texas and the Gila Valley of Arizona, are, however, separated by this upper division of the zone, and their characteristic plants, mammals, and reptiles are widely different. The characteristic birds of the two regions are for obvious reasons more nearly the same.

There are practically no permanent streams over these dry plains, but in many places good water lies near the surface, and some agriculture is carried on by pumping or by storing flood water.

Grazing is generally sparse and poor, but it could be greatly improved by a system of cross furrowing to hold the rain where it falls on the sloping surfaces and by closing the arroyos so as to turn the water out over dry mesas. This would also prevent the formation of great shallow lakes in the valley bottoms which in drying up leave miles of worthless mud flats or "playas." Because of the mild winters and the fact that the grasses cure well and retain their nutriment, the grazing would be especially valuable if the grass were more abundant.

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[1] Valle Jornada del Muerto, the "valley of the journey of death," was so named from the death of the Spanish refugees who perished there of thirst in 1680 on their flight down its waterless stretch of 90 miles to Old Mexico. In 1867 Gen. H. C. Merriam marched his infantry down this valley with the water each man could carry in his canteen, covering the distance in three night marches, with no great suffering or danger. Now stock ranches dot the valley here and there, and windmills and water tanks may be seen from the train.

GILA VALLEY.

The Lower Sonoran Zone extends up the Gila Valley into New Mexico for about 50 miles, or a little beyond Cliff, and strong traces of it reach up the Valley of the San Francisco, a northern branch of the Gila, well within the State. These valleys are narrow, but both contain rich agricultural land with abundance of pure water for irrigation.

The characteristic Lower Sonoran plants of the Gila Valley are creosote bush, mesquite, acacia, mimosa, chilopsis, fouquieria, zizyphus, sapindus, atriplex, *Yucca radiosa*, and several species of cactus. Its birds are Gambel's and scaled quail, road-runner, Gila woodpecker, Texas woodpecker, vermilion flycatcher, black phoebe, Abert's towhee, cactus wren, and crissal thrasher.

Its mammals are the large and small kangaroo rats (*Dipodomys spectabilis* and *D. merriami*), Ord kangaroo rat (*Perodipus ordi*), Baird pocket mouse (*Perognathus flavus*), Arizona grasshopper mouse (*Onychomys torridus*), Anthony white-footed mouse (*Peromyscus anthonyi*), Arizona pocket gopher (*Thomomys cervinus*), little canyon bat (*Pipistrellus hesperus*), New Mexico desert fox (*Vulpes macrotis neomexicana*), and probably the gray-tailed antelope squirrel (*Ammospermophilus harrisi*), which at least comes near the line and which enters the Animas Valley farther south.

CHARACTERISTIC LOWER SONORAN SPECIES IN NEW MEXICO.

The following list of mammals, birds, reptiles, and plants includes the species that best mark the limits of the Lower Sonoran Zone in New Mexico. Comparatively few of these occur throughout the zone and some reach only into a corner or inhabit a very restricted area in the State.

Only breeding birds are given in the zone lists, as the greater number of migrants passing through on their way north and south occur in practically the whole of the State at one time or another with little regard to zonal limits. Also some of the birds that breed in the higher zones of the State spend the winters in the lower zones, while others breeding in the low hot zones hurry into the mountains or a higher zone when the breeding season is over and remain there during the dryest and hottest part of summer. Some of the birds breed as early as February and March, while others breed in midsummer, and many breed more than once in a season, so that the mere presence of a bird at a given locality in summer is not always sufficient evidence of its breeding there. The actual breeding ranges of many species are not well determined. In some cases the records are few and some of these may be erroneous, so that the present lists are only provisional.

Mammals are generally more stable in their range, but some are more or less migratory or nomadic, and others are adapted to a wide range of climatic and environmental conditions. Some of the common species are therefore not included in the zone lists, being found in so many zones that their distribution has little zonal significance. Most of the species, however, are very constant in their range.

MAMMALS OF THE LOWER SONORAN ZONE IN NEW MEXICO.

[Species marked *U.* occur also in Upper Sonoran Zone.]

Didelphis mexicanus texensis, Texas Opossum.
Tatu novemcinctum texanum, Texas Armadillo.
Tayassu angulatum, Texas Peccary.
Ammospermophilus interpres, Texas Antelope Squirrel.
Ammospermophilus harrisi, Gray-tailed Antelope Squirrel.
Citellus mexicanus parvidens, Rio Grande Ground Squirrel.
Citellus spilosoma macrospilotus, Spotted Ground Squirrel.
Citellus spilosoma arens, Spotted Sand Squirrel.
Onychomys torridus, Arizona Grasshopper Mouse.
Peromyscus eremicus, Desert White-footed Mouse.
Peromyscus eremicus anthonyi, Anthony White-footed Mouse.
Peromyscus leucopus tornillo, Tornillo White-footed Mouse
Peromyscus leucopus arizonae, Arizona White-footed Mouse.
Reithrodontomys megalotis, Large-eared Harvest Mouse.
Neotoma micropus canescens, Gray Wood Rat.
Sigmodon hispidus berlandieri, Berlandier Cotton Rat.
Sigmodon minimus goldmani, Goldman Cotton Rat.
Fiber zibethicus ripensis, Pecos River Muskrat.
Fiber zibethicus pallidus, Pale Muskrat.
Castor canadensis frondator, Broad-tailed Beaver.
Geomys arenarius, Desert Pocket Gopher.
Thomomys aureus lachuguilla, Lechuguilla Pocket Gopher.
Thomomys cervinus, Arizona Pocket Gopher.
Perognathus penicillatus eremicus, Desert Pocket Mouse.
Perognathus penicillatus pricei, Price Pocket Mouse.
Perognathus intermedius, Intermediate Pocket Mouse.
Perognathus flavus, Baird Pocket Mouse.
Perognathus merriami gilvus, Dutcher Pocket Mouse.
Perodipus ordi, Ord Kangaroo Rat.
Dipodomys merriami, Merriam Kangaroo Rat.
Dipodomys merriami ambiguus, El Paso Kangaroo Rat.
Dipodomys spectabilis, Large Kangaroo Rat. *U.*
Lepus californicus texianus, Texas Jack Rabbit. *U.*
Lepus californicus eremicus, Desert Jack Rabbit.
Sylvilagus auduboni minor, Desert Cottontail.
Felis onca hernandezi, Jaguar.
Vulpes macrotis neomexicana, New Mexico Desert Fox.
Canis mearnsi, Mearns Coyote. *U.*
Procyon lotor mexicanus, Mexican Raccoon.
Nasua narica pallida, Nasua.
Taxidea taxus berlandieri, Mexican Badger. *U.*

MAMMALS OF THE LOWER SONORAN ZONE IN NEW MEXICO—continued.

Mustela frenatus neomexicanus, New Mexico Weasel.
Spilogale leucoparia, Rio Grande Spotted Skunk.
Spilogale ambigua, Chihuahua Spotted Skunk.
Spilogale arizonae, Arizona Spotted Skunk.
Mephitis leucomitra, Hooded Skunk.
Mephitis mesomelas varians, Texas Skunk.
Conepatus mesoleucus mearnsi, Mearns White-backed Skunk.
Notiosorex crawfordi, Eared Shrew.
Myotis yumanensis, Yuma Bat. *U.*
Myotis velifer, Cave Bat. *U.*
Myotis californicus, Little California Bat. *U.*
Myotis thysanodes, Fringed Bat. *U.*
Myotis incautus, House Bat.
Pipistrellus hesperus, Little Canyon Bat.
Antrozous pallidus, Large Pale Bat. *U.*
Nyctinomus mexicanus, Free-tailed Bat.

BREEDING BIRDS OF LOWER SONORAN ZONE IN NEW MEXICO.

[Species marked *U.* occur also in Upper Sonoran Zone.]

Colinus virginianus texanus, Texas Bob-white.
Callipepla squamata, Scaled Quail. *U.*
Lophortyx gambeli, Gambel's Quail.
Melopelia asiatica trudeaui, White-winged Dove.
Parabuteo unicinctus harrisi, Harris's Hawk.
Buteo abbreviatus, Zone-tailed Hawk.
Falco fusco-caerulescens, Aplomado Falcon.
Polyborus cheriway,[1] Audubon's Caracara.
Aluco pratincola,[1] Barn Owl.
Speotyto cunicularia hypugaea, Burrowing Owl. *U.*
Micropallas whitneyi,[1] Elf Owl.
Geococcyx californianus, Road-runner.
Dryobates scalaris cactophilus, Cactus Woodpecker.
Centurus uropygialis, Gila Woodpecker.
Chordeiles acutipennis texensis, Texas Nighthawk.
Calypte costae, Costa's Hummingbird.
Tyrannus vociferans, Cassin's Kingbird. *U.*
Sayornis nigricans, Black Phoebe.
Pyrocephalus rubinus mexicanus, Vermilion Flycatcher.
Otocoris alpestris adusta, Scorched Horned Lark.
Corvus cryptoleucus, White-necked Raven.
Sturnella magna hoopesi, Rio Grande Meadowlark.
Icterus parisorum, Scott's Oriole.
Icterus cucullatus nelsoni, Arizona Hooded Oriole.
Amphispiza bilineata deserticola, Desert Sparrow.
Peucaea cassini, Cassin's Sparrow.
Pipilo aberti, Abert's Towhee.
Cardinalis cardinalis canicaudus, Gray-tailed Cardinal.
Pyrrhuloxia sinuata, Arizona Pyrrhuloxia.
Guiraca caerulea lazula, Western Blue Grosbeak. *U.*
Passerina ciris, Painted Bunting.
Phainopepla nitens, Phainopepla.
Mimus polyglottos leucopterus, Western Mockingbird. *U.*
Toxostoma curvirostre, Curve-billed Thrasher. *U.*
Toxostoma curvirostre palmeri, Palmer's Thrasher.
Toxostoma crissale, Crissal Thrasher.
Heleodytes brunneicapillus couesi, Cactus Wren.
Catherpes mexicanus conspersus, Cañon Wren. *U.*
Auriparus flaviceps, Verdin.
Polioptila plumbea, Plumbeous Gnatcatcher.

REPTILES.

The following lists are mainly from New Mexico specimens in the United States National Museum collection, identified by Dr. Leonhard Stejneger, herpetologist and head curator of zoology. Some additional species are included from a report by Dr. Alexander G. Ruthven on a collection of reptiles and amphibians from southern New Mexico and Arizona. The zonal position of some of the species is based on so few records as to be still somewhat in doubt, but is given as best indicated by the localities represented.

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[1] Record doubtful as to breeding.

REPTILES OF LOWER SONORAN ZONE IN NEW MEXICO.

[Species marked *U.* occur also in Upper Sonoran Zone.]

Lizards.

Crotaphytus wislizeni, Leopard Lizard.
Holbrookia texana, Texas Spotted-tailed Lizard.
Holbrookia propinqua, Spotted-tailed Lizard.
Uta stansburiana, Stansbury Lizard. *U.*
Sceloporus magister, Great Scaly Lizard.
Sceloporus clarki, Clark Scaly Lizard.
Sceloporus consobrinus, Fence Scaly Lizard. *U.*
Phrynosoma cornutum, Texas Horned Lizard.
Phrynosoma modestum, Gray Horned Lizard. *U.*
Cnemidophorus gularis, Whip-tailed Lizard. *U.*
Cnemidophorus tigris, Striped Whip-tailed Lizard. *U.*
Cnemidophorus melanostethus, Whip-tailed Lizard.
Cnemidophorus sexlineatus, Six-lined Lizard.
Heloderma suspectum [1], Gila Monster.
Coleonyx brevis, Gecko.

Snakes.

Leptotyphlops dulcis, Burrowing Snake.
Thamnophis marciana, Marcy's Garter Snake.
Natrix transversa, Water Snake.
Salvadora hexalepis, Flat-nosed Snake.
Salvadora grahamiae, Graham Snake.
Elaphe emoryi, Emory's Snake.
Bascanion flagellum, Coachwhip Snake.
Arizona elegans, Arizona Snake.
Opheodrys aestivus, Rough Green Snake. *U.*
Hypsiglena ochrorhyncha, Rock Snake.
Rhinocheilus lecontei, LeConte's Snake.
Lampropeltis getulus splendidus, King Snake.
Lampropeltis pyrrhomelanus. *U.*
Lampropeltis pyrrhomelanus celaenops.
Diadophis regalis, Ring Snake.
Gyalopium canum.
Tantilla planiceps, Plain-headed Little Snake.
Sistrurus catenatus edwardsi, Massasauga.
Crotalus atrox, Western Diamond Rattlesnake.

PLANTS OF LOWER SONORAN ZONE IN NEW MEXICO.

[Species marked *U.* occur also in the Upper Sonoran Zone.]

Trees, shrubs, and herbaceous plants.

Covillea glutinosa, Creosote Bush.[2]
Prosopis glandulosa, Mesquite.
Prosopis pubescens, Screw Bean, Tornillo.
Acacia constricta, Straight-spined Acacia.
Acacia greggi, Devil's Claw.
Acacia filicioides, Spineless Acacia.
Cassia wislizeni, Senna.
Cassia lindheimeriana, Senna.
Cassia roemeriana, Senna.
Cassia bauhinioides, Senna.
Hoffmanseggia densiflora.
Sophora secundiflora, Coral Bean.
Parosela frutescens, Dalea.
Parosela formosa, Dalea.
Parosela scoparia, Dalea.
Parosela lachnostachys, Dalea.
Lupinus micensis, Lupine.
Astragalus wootoni, Milk Vetch.
Populus wislizeni, Rio Grande Cottonwood. *U.*
Juglans rupestris, Dwarf Walnut.
Quercus havardi, Havard Oak.

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[1] Reported on Gila River by residents.

[2] The plants most important in marking the life zones have been given precedence in the lists as far as is possible without separating related species.

PLANTS OF LOWER SONORAN ZONE IN NEW MEXICO—continued.

Trees, shrubs, and herbaceous plants—Continued.

Sambucus mexicanus, Mexican Elderberry.
Fouquieria splendens, Ocotillo, Devil's-walking-stick.
Koeberlinia spinosa, Allthorn.
Condalia spathulata.
Zizyphus obtusifolia, Blue-thorn.
Zizyphus lycioides, Blue-thorn.
Rhoedium microphyllum.
Mortonia scabrella.
Schmaltzia microphylla, Small-leaved Sumac.
Schmaltzia virens, Green Sumac.
Sapindus drummondi, Soapberry Tree.
Chilopsis linearis, Desert Willow.
Berberis trifoliolata, Three-leaved Barberry.
Jamesia gracilis.
Ungnadia speciosa, Mexican Buckeye.
Krameria canescens, Gray Chacata.
Krameria parvifolia, Dotted Chacata.
Krameria glandusola, Glandular Chacata.
Lycium torreyi, Torrey Lycium.
Lycium parviflorum, Small-flowered Lycium.
Allenrolfea occidentalis, Western Glasswort.
Cladothrix suffruticosa.
Cladothrix lanuginosa.
Dondia suffrutescens.
Atriplex acanthocarpa, Rough Saltbush.
Atriplex canescens, Gray Saltbush. *U.*
Atriplex elegans.
Atriplex expansa.
Flourensia cernua, Varnish Bush.
Baccharis viminea, Green Baccharis.
Baccharis glutinosa, Sticky Baccharis.
Baccharis pteronoides, Winged Baccharis.
Pluchea sericea, Gray Arrowwood.
Hymenoclea monogyra.
Coleosanthus laciniatus.
Gutierrezia lucida.
Gutierrezia glomerella.
Crassina pumila, Zinnia.
Artemisia filifolia, Narrow-leaved Sagebrush.
Ephedra trifurca, Three-scale Joint Fir.
Ephedra torreyana, Torrey Joint Fir. *U.*
Thamnosma texanum, Stinkbush.
Phoradendron macrophyllum, Mistletoe.
Agave lechuguilla, Lechuguilla, Little Century Plant.
Agave parryi, Parry Century Plant.
Dasylirion texanum, Texas Sotol.
Dasylirion wheeleri, Wheeler Sotol.
Dasylirion leiophyllum.
Yucca macrocarpa, Large-fruited Yucca, Spanish Bayonet.
Yucca radiosa, Narrow-leaved Tree Yucca.
Opuntia leptocaulis, Slender Bush Cactus.
Opuntia kleiniae, Slender Bush Cactus.
Opuntia arenaria, Sand Cactus.
Opuntia emoryi, Emory Prickly Pear.
Opuntia chlorotica, Green Prickly Pear.
Opuntia macrocentra, Long-spined Prickly Pear.
Opuntia dulcis, Sweet Prickly Pear.
Opuntia filipendula, Prickly Pear.
Opuntia toumeyi, Toumey Prickly Pear.
Opuntia chihuahuaensis, Chihuahua Prickly Pear.
Mamillaria grahami, Graham Pincushion Cactus.
Mamillaria macromeris, Large-spined Pincushion Cactus.
Mamillaria scheeri, Scheer Pincushion Cactus.
Echinocactus wislizeni, Devil's-head Cactus, Visnaga.
Echinocactus horizonthalonius, Little Devil's-head.
Echinocereus chloranthus, Green-flowered Petaya.
Echinocereus dasyacanthus, Yellow-flowered Petaya.
Echinocereus stramineus, Purple-flowered Petaya.
Echinocereus neomexicanus, New Mexico Petaya.
Jatropha macrorhiza, Spurge.
Croton corymbulosus, Spurge.
Croton neomexicanus, Spurge.
Ditaxis laevis, Spurge.
Chamaesyce serrula, Spurge.
Chamaesyce revoluta, Spurge.
Chamaesyce flagelliformis, Spurge.
Chamaesyce chaetocalyx, Spurge.
Chamaesyce lata, Spurge. *U.*
Chamaesyce albomarginata, Spurge. *U.*
Chamaesyce serpens, Spurge. *U.*
Kallstroemia grandiflora, Caltrop.
Kallstroemia brachystylis, Caltrop.
Kallstroemia hirsutissima, Caltrop.

PLANTS OF LOWER SONORAN ZONE IN NEW MEXICO—continued.

Trees, shrubs, and herbaceous plants—Continued.

Anemopsis californica, Marsh Pepperroot.
Eriogonum abertianum, Eriogonum.
Eriogonum trichopodum, Eriogonum.
Rumex hymenosepalus, Dock.
Rumex ellipticus, Dock.
Frankenia jamesi.
Juncus mexicanus, Rush.
Cyperus erythrorhizos, Cyperus.

Grasses.

Amphilophis saccharoides.
Schizachyrium neomexicanum, New Mexico Broom Grass.
Hilaria mutica, Tabosa Grass, Galleta Grass.
Eriochloa punctata.
Panicum fasciculatum chartiginense, Panic Grass.
Chaetochloa composita, Foxtail Grass.
Paspalum distichum, Joint Grass.
Aristida bromoides, Poverty Grass, Needle Grass.
Aristida divaricata, Poverty Grass.
Aristida schiediana, Poverty Grass.
Aristida havardi, Poverty Grass.
Sporobolus giganteus, Bunch Grass.
Sporobolus wrighti, Bunch Grass.
Sporobolus auriculatus, Bunch Grass.
Sporobolus airoides, Bunch Grass. *U.*
Sporobolus nealleyi, Bunch Grass.
Sporobolus strictus, Bunch Grass. *U.*
Sporobolus asperifolius, Bunch Grass. *U.*
Sporobolus flexuosus, Bunch Grass. *U.*
Agrostis stolonifera, Redtop. *U.*
Chloris elegans.
Chloris brevispica.
Chloris cucullata.
Muhlenbergia texana, Texas Dropseed Grass.
Bouteloua vestita, Grama.
Bouteloua aristidoides, Six-weeks Grama.
Bouteloua polystachya, Six-weeks Grama. *U.*
Bouteloua eripoda, Black Grama. *U.*
Bouteloua breviseta, Black Grama.
Leptochloa fascicularis.
Papophorum wrighti.
Schleropogon brevifolius, Needle Grass. *U.*
Arundo donax, Cane (introduced?).
Munroa squarrosa, False Buffalo Grass. *U.*
Dasyochloa pulchella. *U.*
Tridens muticus. *U.*
Eragrostis obtusiflora, Skunk Grass.
Distichlis spicata, Salt Grass. *U.*

LOWER SONORAN ZONE CROPS.

The local adaptation of crops in the various States is being tested by experts at agricultural experiment stations and substations. In New Mexico the station which is connected with the College of Agriculture and Mechanic Arts is located at Mesilla Park in the Rio Grande Valley about 40 miles north of El Paso, Tex. Its altitude is 3,865 feet and its location could not be better chosen as a center for the Lower Sonoran Zone area of New Mexico. Fruits and crops which succeed there should under proper conditions do well in any part of the zone in the State. So far as possible I have made use of the published reports of this station,[1] supplemented by my own field notes and those of other members of the Biological Survey.

The recent report of a committee of the American Pomological Society, entitled Fruits Recommended by the American Pomological Society for Cultivation in Various Sections of the United States and Canada,[2] has proved a helpful guide to the nomenclature of fruits and has been followed as far as possible.

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[1] The next available experiment stations in this zone are at Tucson, Ariz., and College Point, Tex., both in different subdivisions of the zone, where many of the tests are unsafe for application to the New Mexico conditions.

[2] Bull. 151, Bur. of Plant Industry, U. S. Dept. Agric., 1909.

PEACHES.

The upper division of the Lower Sonoran Zone produces peaches of excellent quality and flavor, but in the New Mexico section of this zone most varieties bloom in March or early April and the fruit buds are often killed by early April frosts. The early ripening varieties, however, are the latest to bloom, and many of these have withstood the frosts fairly well. The best of 147 varieties tested for four years of bearing by Prof. Fabian Garcia at Mesilla Park, N. Mex., are listed as follows:[1]

Alexander.
Arkansas Traveler.
Waterloo.
Gov. Garland.
S. G. French.
Boyle's Early.
Hynes's Surprise.
Family Favorite.
Muir.
George IV.
Sargent.
Early Silver.
Hoover's Heath.

The following were added to the list by Prof. Garcia in 1910:

Texas King.
Crothers.
Salway.

APRICOTS.

In the Lower Sonoran Zone in New Mexico apricots usually bloom in March or February and the young fruit is consequently killed by spring frosts. Seedling trees bear some fruit at irregular intervals, but varieties of commercial value are not recommended.

PLUMS.

Many excellent varieties of European and American plums are reported a success in the Lower Sonoran Zone at the experiment station at Mesilla Park after a six-year test.[2] The most successful are:

Imperial Gage.
Yellow Egg.
German Prune.
Pond's Seedling.
Golden Drop (Coe's).
Italian Prune.
Tragedy.
Englebert (Prince).
Spaulding.
St. Catherine.
Clyman.
French Prune.
Golden Prune.
Jefferson.
Royal Hative.
Golden Beauty.
Wayland.
Wild Goose.
Bulgarian.
Fellenberg.

APPLES.

Few apples reach their highest development in the lower division of the Lower Sonoran Zone, but many varieties yield well and are valuable crops in the upper division of this zone. Along the Rio Grande Valley in Dona Ana County, where they have been thoroughly tested, the most satisfactory varieties are listed as follows:[3]

Ben Davis.
Gano.
Arkansas (Mammoth BlackTwig).
Missouri Pippin.
Jonathan.
White Pearmain.
Yellow Transparent.
Arkansas Black.

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[1] Garcia, F., Effect of Spring Frosts on the Peach Crop, Bull. 30, New Mex. Agric. Exp. Sta., p. 252, 1899.

[2] Vestal, G., and Garcia, F., Report on Plums, Bull. 27, New Mex. Agric. Exp. Sta., p. 124, 1898. Also Garcia, F., Orchard Notes, Bull. 39, p. 116, 1901.

[3] Garcia, F., Apple Culture and Irrigation, Bull. 75, New Mex. Agric. Exp. Sta., p. 28, 1910.

QUINCES.

The following have been reported as successful at the experiment station at Mesilla Park:[1]

Champion.
Missouri Mammoth.
Orange.

GRAPES.

Of a large number of varieties of grapes tested at Mesilla Park those recorded as most satisfactory are:[2]

Mission.
Alexandria (Muscat of Alexandria).
Chasselas de Fontainbleau.
Thompson's Seedless.
Purple Damascus.
Emperor.
Black Cornichon.
Flame Tokay.

Other satisfactory varieties given are:

Chasselas Rose.
Chasselas Croquant.
Golden Chasselas.
Muscat Proceco Du Puy de Dome.
Early Madeleine.
Cannonhall Muscat.
Black Hamburg.
Blue Spanish.
Hausco.
Rose of Peru.
Malaga.
Gros Coleman.

WATERMELONS.

Among many varieties tested in the Lower Sonoran Zone at Mesilla Park, those recommended as most satisfactory are:[3]

Phinney's Early.
Cuban Queen.
Mammoth Ironclad.
Gypsy (Rattlesnake).
Florida Favorite.

MUSKMELONS AND CANTALOUPES.

The Rocky Ford cantaloupe is given as the most satisfactory variety for general purposes. Those recommended are:[3]

Rocky Ford.
Netted Gem.
Osage.
Netted Nutmeg.
Hackensack.

ONIONS.

The onions recommended by the experiment station at Mesilla Park are:[4]

Early White Queen.
Barletta.
White Bermuda.
Extra Early White Pearl.
Red Victoria.
Prize Taker.
Gigantic Gibraltar.
Australian Brown.
Denia (the real Spanish Onion).

SWEET POTATOES.

From many varieties tested at Mesilla Park the following were selected as the best:[5]

White Bermuda.
Red Bermuda.
Yellow Nansemond.
Cooney.
Vineland Bunch.

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[1] Garcia, F., Orchard Notes, Bull. 39, New Mex. Agric. Exp. Sta., p. 126, 1901.

[2] Garcia, F., European Grapes, Bull. 58, New Mex. Agric. Exp. Sta., pp. 18, 19, 1906.

[3] Garcia, F., Melon Culture, Bull. 63, New Mex. Agric. Exp. Sta., p. 38, 1907.

[4] Garcia, F., Onion Culture, Bull. 52, New Mex. Agric. Exp. Sta., p. 21, 1904; also Onion Tests, Bull. 74, 1910; and Growing Denia Onion Seed, Bull. 82, 1912.

[5] Garcia, F., Sweet Potato Culture, Bull. 70, New Mex. Agric. Exp. Sta., 1909.

MISCELLANEOUS CROPS.

Almonds, figs, and some of the more delicate grapes and other Lower Sonoran fruits do not thrive without unusual care and protection.

I have seen fairly good cotton growing and matured in the Rio Grande and Pecos Valleys in New Mexico, but it can not be considered a safe or profitable crop, since the season without frost is normally too short for it to mature.

UPPER SONORAN ZONE.

(*The zone of juniper, nut pine, and blue grama grass.*)

Most of the plains and foothill country of New Mexico and the valleys lying above 5,000 feet are included in the Upper Sonoran, the arid division of the transcontinental Upper Austral Zone. Its lower border in the Pecos Valley is approximately 4,000 feet and in the Rio Grande and Gila Valleys 4,500, varying of course with slope exposure. The upper border of the zone varies from approximately 7,000 to 8,000 feet, on steep and barren southwest slopes sometimes reaching above 8,000, and on steep northeast slopes sometimes falling below 7,000. It comprises approximately 92,000 square miles, or two-thirds of the total area of New Mexico, and includes a large part of the grazing and agricultural land. Its climate is mild without great extremes of heat or cold. While the zone is mainly arid, there is sufficient rainfall over most of it for good grass, but not enough for ordinary agriculture. Under irrigation the rich soil produces well and the zone is peculiarly adapted to the perfection of many fruits and other farm crops.

The principal subdivisions of the Upper Sonoran Zone in New Mexico are based mainly on differences of humidity and are not very strongly marked. The most evident divisions are those of the *Great Plains* and *Great Basin.*

GREAT PLAINS DIVISION.

The Upper Sonoran plains of New Mexico east of the Rio Grande Valley include nearly half of the Llano Estacado, broad slopes east and west of the Pecos Valley, and the plains north of the Canadian River Valley. This area belongs to the Great Plains division of the zone and having an average rainfall of only about 15 inches may be classed as semiarid. It is mainly characterized by abundant grass, and has evidently been kept treeless by ages of sweeping winds and fires.[1] Originally it was choice buffalo range, as it is now largely choice cattle range, though parts of it are rapidly yielding to dry farming. Along the western edge of this area, where foothills and deep gulches join it to the mountains, and over the rough "breaks" north of the Staked Plains, scrubby orchardlike forests of junipers, nut pines, and oaks have withstood the fires and now lead up from grassy plain to mountain forest. Besides the numerous grasses, these plains are characterized by narrow-leaved yuccas (*Yucca glauca*), prickly pears (*Opuntia cymochila* and *O. camanchica*), milkweeds (*Asclepias latifolia* and *A. speciosa*), blazing star (*Laciniaria punctata*), *Polygala alba*, *Psoralea linearifolia*, *Astragalus caryocarpus*, and *A. molissimus;* by such breeding birds as mountain plover, long-billed curlew, western nighthawk, desert horned lark, and western meadowlark; and by such mammals as the black-tailed prairie dog, black-footed ferret, plains jack rabbit, pale 13-lined ground squirrel, pale grasshopper mouse, Nebraska white-footed mouse, Cope and Kansas pocket mice, and Richardson kangaroo rat; and by the collared lizard and hog-nosed snake.

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[1] To those who have tried in vain to protect young trees from the fierce winds of the plains and have seen the green leaves actually torn off, the bark cut through against protecting frames, or deep funnels bored in the ground by the whipping of the unprotected trunks, the lack of trees needs no further explanation. If additional reason were needed, the spectacle of a torrent of fire driven before the same winds over the dense carpet of grass would suffice.

The agricultural development of this region without irrigation is as yet in an experimental stage, depending on control of the moisture in the soil. Great progress has been made in "dry-farming" methods, but the danger from a series of dry years is not yet eliminated. The soil is rich, and with proper treatment often gives a good yield of many standard crops without irrigation. Along the upper Pecos and Canadian Rivers and many of their branches there is abundant water for irrigation if it can be properly conserved during the seasons of high water and floods. Throughout the Plains region many of the dry washes at times become raging torrents that go to waste and carry destruction before them.

The crops best adapted to this division of Upper Sonoran Zone, provided sufficient moisture is obtainable, were listed by Dr. C. Hart Merriam in 1898 on as full data as were available at that time.[1] The cereals and fruits listed, while of general application to the arid Upper Sonoran, are not all adapted to all of its local subdivisions. For instance, on the open plains very few fruits can be raised until substantial windbreaks are provided. On hot slopes many fruit trees blossom so early that the later frosts invariably kill the fruit. But the aridity of the Great Plains has proved the greatest barrier to fruit raising except where irrigation is possible.

At present the best available testing grounds for the crops of the Great Plains region of eastern New Mexico are the experiment station at Fort Collins, Colo., and its substations at Cheyenne Wells and Rocky Ford. The results of 23 years' experiments published in numerous reports of the station should be a fairly safe guide to crop adaptations in this region.

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[1] Life Zones and Crop Zones of the United States, Bull. 10, Biological Survey, U. S. Dept. Agric., pp. 37-40 and 56-73, 1898.

The United States Dry Land Experiment Station at Akron, Colo., is also in this division of Upper Sonoran Zone and has conditions of climate and aridity very similar to those of the eastern New Mexico plains. The reports of the superintendent of this station therefore apply to practically all of the "dry-farming region" of eastern New Mexico.

The Bureau of Plant Industry also has published provisional lists of fruits for the Central and Southern Great Plains, which are especially applicable to this part of the zone in New Mexico.[1]

Lists of crops recommended in various reports are not given here, since without the accompanying notes on culture, relative value of the crops, and the probabilities of success, such a compilation would be in many cases misleading and a source of danger.

Great Basin Division.

The Colorado drainage includes the valleys of the Gila, the Zuni, and San Juan Rivers. These and the Rio Grande Valley Upper Sonoran are in fauna and flora essentially a part of the Great Basin division of the zone. Both upper and lower divisions of the zone may also be traced irregularly throughout the more arid parts of the State, and especially in the Rio Grande and San Juan Valleys. These subdivisions are likewise due mainly to greater or less aridity, the higher borders of the zone receiving more rainfall and the lower valleys less. The upper (nut pine and juniper) subdivision forms a wide or narrow border as restricted by soil, moisture, and fire. The lower, open, more arid valley bottoms and slopes, clothed with scattered grass, cactuses, yuccas, and low desert shrubs, are marked by the absence of trees except along streams.

RIO GRANDE VALLEY.

A great part of the Upper Sonoran Zone in the Rio Grande Valley is extremely arid, having an average annual rainfall of only about 10 inches. It is generally characterized by sparse vegetation, consisting largely of desert shrubs, cactuses, yuccas, and short grasses. Over extensive areas of level land where the rainfall is all absorbed or where flood water spreads out, there is good grazing at certain seasons, but many of the steeper slopes from which the water runs quickly are very dry and barren. The higher edges of the zone are conspicuously less arid, and the rough broken mesas and foothill areas are generally covered with a scattered growth of juniper and nut pine and a better stand of grass.

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[1] Gould, H. P., Fruit Growing for Home Use in the Central and Southern Great Plains, Circ. 51, Bur. Plant Industry, U. S. Dept. Agric., 1910.

Excluding grasses, some of the most characteristic Upper Sonoran plants in open plains and valleys are cat's-claw (*Mimosa biuncifera*), saltbush (*Atriplex confertifolia* and *A. canescens*), white sage (*Eurotia lanata*), rabbit brush (*Chrysothamnus, Tetradymia, Chrysoma,* and *Gutierrezia*), sagebrush (*Artemisia*), *Ximenesia exauriculata,* Spanish bayonet (*Yucca baccata*), *Yucca glauca,* bear grass (*Nolina lindheimeriana*), and many species of cactus. In the foothills and rough borders of the valleys the conspicuous vegetation consists of nut pine (*Pinus edulis*), junipers (*Juniperus monosperma, J. pachyphloea,* and *J. scopulorum*), live oaks (*Quercus arizonica* and *Q. emoryi*), sumacs (*Schmaltzia trilobata* and *S. pumila*), mountain mahogany (*Cercocarpus parvifolius*), silk tassel (*Garrya goldmani* and *G. wrighti*), mescal (*Agave parryi*), and several species of cactus.

A few of the most characteristic Upper Sonoran birds of the Rio Grande Valley are Woodhouse's jay (*Aphelocoma woodhousei*), piñon jay (*Cyanocephalus cyanocephalus*), cañon towhee (*Pipilo fuscus mesoleucus*), lead-colored bush tit (*Psaltriparus plumbeus*), gray titmouse (*Bæolophus inornatus griseus*), and Montezuma horned lark (*Otocoris alpestris occidentalis*).

Its most characteristic mammals are kangaroo rats (*Perodipus montanus, P. longipes,* and *Dipodomys spectabilis*), Apache pocket mouse (*Perognathus apache*), white-throated wood rat (*Neotoma albigula*), gray-tailed prairie dog, large spotted ground squirrel (*Citellus spilosoma major*), pale grasshopper mouse (*Onychomys leucogaster melanophrys*), big-eared and Rowley white-footed mice (*Peromyscus truei* and *P. boylei rowleyi*), Texas jack rabbit (*Lepus californicus texianus*), and cedar belt cottontail (*Sylvilagus auduboni cedrophilus*).

Agriculture in the Rio Grande Valley is rarely attempted except where irrigation is possible, but in places where a good supply of water is available the extreme aridity is a distinct advantage, since it permits full control of soil moisture and thus makes possible the highest development of many farm crops.

COLORADO VALLEY.

In extreme western New Mexico considerable areas of Upper Sonoran Zone lie in the Colorado River drainage, as represented by the valleys of the Gila, the Little Colorado, and the San Juan. These valleys vary from 5,000 to 7,000 feet in altitude and show evidence of considerable variation in aridity. Each draws species both from the Arizona deserts and from the Rio Grande Valley, between which there is no barrier and no strong line of demarcation. Still a slight difference of climatic conditions is shown that probably can be taken advantage of in practical ways, and it is important to define these areas and determine their extent and local characteristics.

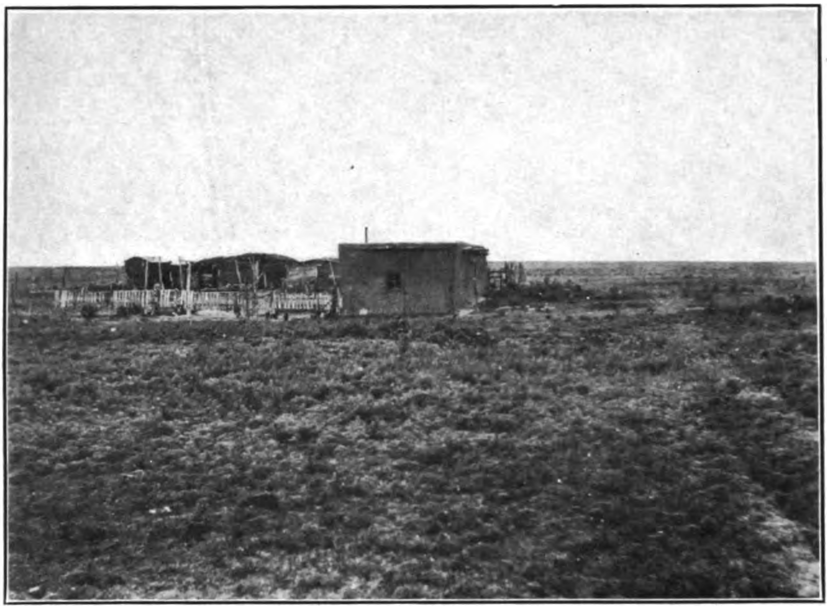

FIG. 1.—TYPICAL GREAT PLAINS COUNTRY NEAR CLAYTON IN NORTHEASTERN NEW MEXICO.

Low grasses are the principal vegetation. Photograph by A. H. Howell.

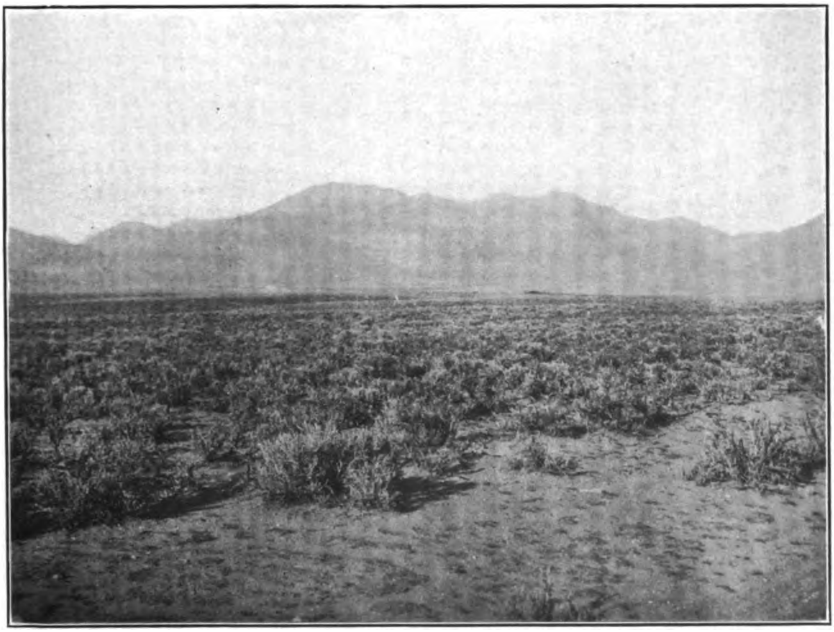

FIG. 2.—TYPICAL GREAT BASIN VEGETATION OF THE RIO GRANDE VALLEY NEAR TAOS, NEW MEXICO.

Sagebrush is the principal vegetation.

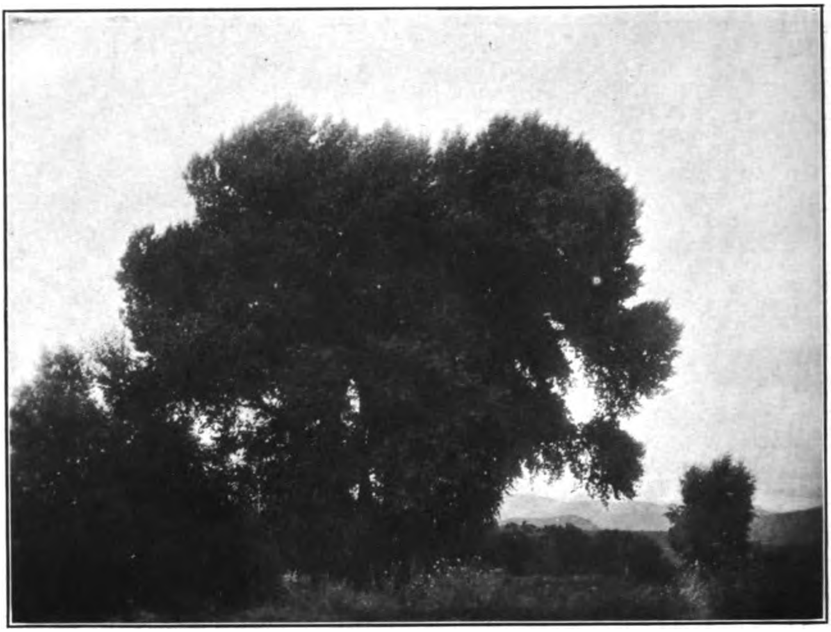

FIG. 1.—LANCE-LEAVED COTTONWOOD (POPULUS ACUMINATA) NEAR RESERVE IN THE VALLEY OF SAN FRANCISCO RIVER.

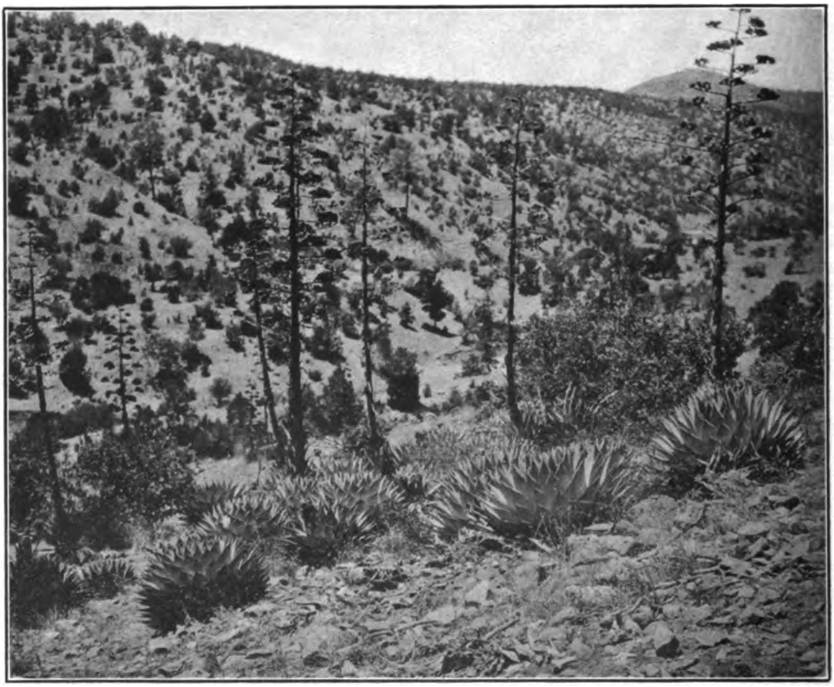

FIG. 2.—THE MESCAL PLANT (AGAVE PARRYI) NEAR THE HEAD OF THE RIO MIMBRES ON SLOPE COVERED WITH NUT PINE, JUNIPER, AND OTHER UPPER SONORAN VEGETATION.

GILA VALLEY.

The Upper Sonoran area of the Gila drainage is generally very rough, steep, and broken, and is largely occupied by a scattered growth of oaks, junipers, and nut pines. Along the upper valleys of the Gila and the San Francisco, including their side streams, are level areas of sufficient extent for a few good farms with plenty of pure water for irrigation. Owing to its proximity to the Mogollon and other mountain masses this area receives an unusual amount of rainfall and has in consequence a rich growth of the best forage grasses. In many ways it is an ideal stock country and the little agriculture is now mainly supplemental to stock raising and mining. It is a region of sheltered valleys under the shadow of big forested mountains, of warm winter canyons with numerous cave and cliff dwellings, and of abundant food-yielding plants and animals; a region which is full of wild charm and was defended long and savagely by its primitive occupants. In the canyons are a profusion of wild grapes, currants, wild cherries, hackberries, mulberries, walnuts, and black and blue live oaks, while on the ridges junipers, nut pines, and oaks abound. Fruit-bearing cactuses and yuccas are abundant, and the mescal agave grows in profusion on some of the slopes.

Some of the most characteristic plants of this area are the Arizona walnut, big-seeded juniper, boxelder, lance-leaved cottonwood, tree alder, wild grape, and velvet-leaved sumac. The bridled titmouse and Scott's sparrow are characteristic Upper Sonoran breeding birds. Among mammals the Sonora white-tailed deer, Arizona gray squirrel, rock squirrel, rock chipmunk. Stephens wood rat, and civet cat are characteristic

LITTLE COLORADO DRAINAGE.

The New Mexico tributaries of the Little Colorado River, the Zuni, Puerco, and Carrizo, with their branches, are at most times mere dry washes that head in a high plateau region of well-grassed valleys and well-wooded ridges and mesas. This drainage area lies close to the Continental Divide in west central New Mexico, mainly west and south of the Zuni Mountains, and would include the many basins and sinks west of the Datil Mountains if there were sufficient rainfall to overflow their rims. While there is enough rain to produce good forage grasses and much juniper and nut pine forest, there are few permanent streams and only occasional springs. Limited areas could be brought under cultivation by water storage, but at present the region is almost entirely devoted to stock raising, to which it is admirably adapted. It has few characteristic species except those belonging to the upper or nut pine division of the Upper Sonoran Zone.

The Zuni Indians of this region have long supported themselves in part by a primitive type of dry farming, planting little patches of corn, squashes, and beans on spots that received an extra flow of rain water or on which in time of rain the flood water could be diverted to the crops. In 1853 Lieut. Whipple reported that without irrigation they produced abundant crops of grain and vegetables, and that after furnishing forage to Fort Defiance their supply of maize seemed inexhaustible.[1] They now have a good system of irrigation, but the people of the Ojo Caliente pueblo still have garden patches scattered over many little valleys where surprisingly good crops are often gathered with little or no cultivation or irrigation.

PLAIN OF SAN AUGUSTINE.

The San Augustine plain is 25 miles wide and extends 60 or 70 miles along the Continental Divide in western Socorro County at an altitude ranging from 6,800 to 7,500 feet. It is an arid treeless plain or shallow basin on top of the plateau, partly surrounded by short irregular mountain ranges. It lies wholly in the Upper Sonoran Zone, has a fertile soil, and but for aridity would be valuable for agriculture. There are numerous arroyos cutting down from the surrounding mountains which in time of rain are short-lived torrents, but for most of the year are mere dry washes.

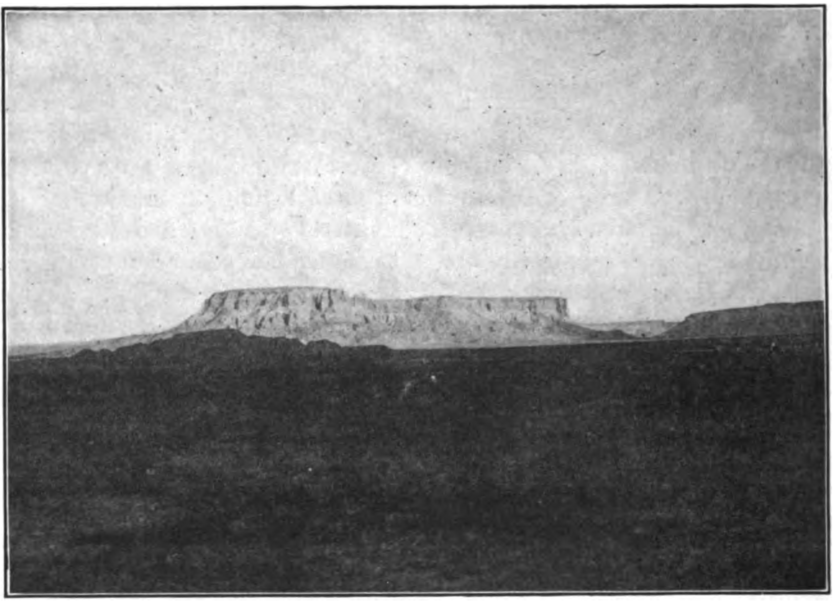

FIG. 2.—Zuni Valley and Thunder Mountain, site of the old Pueblo of Zuni, a few miles east of the present pueblo.

Permanent water is scarce and confined to springs and a few short creeks, mainly along the foothill slopes of bordering mountain ranges. There are a few scattering stock ranches with headquarters at the springs or watercourses, but practically no agriculture is attempted.

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[1] Rept. Expl. and Surv. R. R. Pacific, III, p. 14, 1856.

The bordering foothills and some rough parts of the valley have a scattered growth of juniper, nut pine, and scrub oaks, but the greater part of the plain is open country with a scattered growth of grass and desert shrubs, such as gray saltbush, white sage, and various genera and species of rabbit brush (*Chrysothamnus*, *Gutierrezia*, and *Tetradymia*).

SAN JUAN RIVER VALLEY.

An extensive area in northwestern New Mexico drained by the San Juan River and its tributaries lies entirely in Upper Sonoran Zone and mainly in its lower or valley division. It is a great arid plain with narrow bordering patches of nut pines, junipers, and oaks along the surrounding foothills and extending over some of the ridges and mesa tops. Its dominant plants and animals are those of the Great Basin Region, and a few of these do not reach even to the Rio Grande Valley. Some of these are: Utah juniper (*Juniperus utahensis*), buffalo berry (*Lepargyrea argentea*), Rocky Mountain birch (*Betula fontinalis*), and cliff rose (*Cowania mexicana*); the Hopi chipmunk (*Eutamias hopiensis*), buff-breasted canyon mouse (*Peromyscus crinitus auripectus*), Thomas wood rat (*Neotoma lepida*), harvest mouse (*Reithrodontomys megalotis aztecus*), Yavapai pocket mouse (*Perognathus flavus bimaculatus*), and Colorado cottontail (*Sylvilogus auduboni warreni*). The magpie is a common resident along the San Juan River, but this and most of the other birds inhabit also the Rio Grande Valley. A colony of eastern blue jays is established there, but they may have been introduced.

This great valley, while mainly an open plain, is also a region of deep erosion, displaying numerous canyons, dry washes, and picturesque badlands, rich coal fields, and interesting fossil beds. The greater part of the valley is waterless for most of the year, but the San Juan River and its northern tributaries furnish a fierce flood of mountain water, ample for irrigating their immediate valleys and some of the mesa country. Most of the present agriculture is near the valley bottoms, but more ditches are being carried over the mesas and higher slopes and eventually the cultivated area will be greatly increased. Already the valley has won a reputation for quality and yield of fruit, specially apples, pears, and peaches.

The greater part of the San Juan Valley is occupied by the Navajo Indian Reservation and is used mainly for stock range. The Indians have large numbers of sheep and horses and some cattle. They move from place to place as the water holes dry up or as the rains fill the pools and bring up the grass. An interesting type of "dry farming" is carried on by them all over the reservation on little flats into which drains more than the usual amount of rain water. Melons, squashes, corn, and beans are planted on any level ground that is occasionally flooded from a "dry wash" or that can be watered by some diverted stream of muddy rain or snow water. There is usually little or no cultivation and still a crop is often harvested that will carry a family through the winter. Under the guidance of Indian agents and their farmers this practice is encouraged and good seed is provided.

CHARACTERISTIC UPPER SONORAN SPECIES OF NEW MEXICO.

The area of Upper Sonoran Zone shown on the accompanying map (frontispiece) in light yellow is based on the range of the following species of animals and plants, some of which occur throughout the zone, others in only a limited part, and still others extend through it from a lower or a higher zone and mark a part of its upper or lower border.

MAMMALS OF UPPER SONORAN ZONE IN NEW MEXICO.

[Species marked *L.* occur also in Lower Sonoran Zone; those marked *T.* also in Transition.]

Tayassu angulatum sonoriense, Sonora Peccary. *L.*

Odocoileus couesi, Sonora Whitetail Deer.

Odocoileus virginianus macrourus, Plains Whitetail Deer. *T.*

Odocoileus hemionus canus, Gray Mule Deer. *T.*

Antilocapra americana, Antelope.

Antilocapra americana mexicana, Mexican Antelope.

Ovis mexicanus, Mexican Mountain Sheep.

Ovis canadensis texianus, Texas Mountain Sheep.

Sciurus arizonensis, Arizona Gray Squirrel.

Eutamias dorsalis, Rock Chipmunk.

Citellus variegatus grammurus, Rock Squirrel.

Citellus spilosoma major, Large Spotted Ground Squirrel.

Citellus spilosoma obsidianus, Dark Spotted Ground Squirrel.

Citellus tridecemlineatus pallidus, Pale Thirteen-Line Ground Squirrel.

Citellus tridecemlineatus parvus, Small Thirteen-Line Ground Squirrel.

Ammospermophilus leucurus cinnamomeus, Antelope Squirrel.

Cynomys ludovicianus, Black-tailed Prairie Dog.

Cynomys gunnisoni, Gray-tailed Prairie Dog. *T.*

Onychomys leucogaster melanophrys, Pale Grasshopper Mouse.

Peromyscus maniculatus blandus, Frosted White-footed Mouse.

Peromyscus boylei rowleyi, Rowley White-footed Mouse.

Peromyscus truei, Big-eared White-footed Mouse.

Peromyscus nasutus, Long-nosed White-footed Mouse.

Peromyscus crinitus auripectus, Buff-breasted Canyon Mouse.

Neotoma albigula, White-throated Wood Rat.

Neotoma albigula warreni, Warren Wood Rat.

Neotoma micropus canescens, Gray Wood Rat. *L.*

Neotoma lepida, Thomas Wood Rat.

Neotoma lepida stephensi, Stephens Wood Rat.

Neotoma cinerea arizonae, Arizona Wood Rat.

Sigmodon minimus, Small Cotton Rat.

Reithrodontomys megalotis aztecus, Aztec Harvest Mouse.

Reithrodontomys griseus, Little Gray Harvest Mouse. *L.*

Microtus pennsylvanicus modestus, Colorado Meadow Mouse. *T.*

Microtus montanus arizonensis, Arizona Meadow Mouse.

MAMMALS OF UPPER SONORAN ZONE IN NEW MEXICO—continued.

Microtus aztecus, Aztec Meadow Mouse.
Fiber zibethicus osoyoosensis, Rocky Mountain Muskrat. *T.*
Fiber zibethicus pallidus, Pale Muskrat. *L.*
Castor canadensis frondator, Broad-tailed Beaver.
Geomys lutescens, Yellow Pocket Gopher.
Cratogeomys castanops, Chestnut-faced Pocket Gopher. *L.*
Thomomys aureus, Golden Pocket Gopher.
Thomomys pervagus, New Mexico Pocket Gopher.
Thomomys baileyi, Bailey Pocket Gopher.
Dipodomys spectabilis, Large Kangaroo Rat. *L.*
Perodipus montanus, Rio Grande Kangaroo Rat.
Perodipus montanus richardsoni, Richardson Kangaroo Rat.
Perodipus longipes, Large-footed Kangaroo Rat.
Perognathus hispidus paradoxus, Kansas Pocket Mouse.
Perognathus apache, Apache Pocket Mouse.
Perognathus flavescens, Plains Pocket Mouse.
Perognathus flavus, Baird Pocket Mouse. *L.*
Perognathus flavus bimaculatus, Yavapai Pocket Mouse.
Lepus californicus texianus, Texas Jack Rabbit. *L.*
Lepus californicus melanotis, Great Plains Jack Rabbit.
Lepus gaillardi, Gaillard Jack Rabbit.
Sylvilagus auduboni neomexicanus, New Mexico Cottontail.
Sylvilagus auduboni cedrophilus, Cedar Belt Cottontail.
Sylvilagus auduboni warreni, Colorado Cottontail.
Felis hippolestes aztecus, Mexican Cougar.
Lynx baileyi, Plateau Wildcat.
Urocyon cinereoargenteus scotti, Gray Fox.
Canis nebracensis, Plains Coyote. *T.*
Canis mearnsi, Mearns Coyote. *L.*
Canis estor, Desert Coyote. *L.*
Canis mexicanus, Mexican Wolf. *T.*
Canis (sp. ?), Plains Wolf. *T.*
Mephitis mesomelas varians, Long-tailed Skunk. *L.*
Mephitis estor, Arizona Skunk. *L.*
Spilogale tenuis, Rocky Mountain Spotted Skunk.
Spilogale ambigua, Chihauhau Spotted Skunk.
Spilogale arizonae, Arizona Spotted Skunk.
Spilogale gracilis saxatilis, Great Basin Spotted Skunk.
Taxidea taxus berlandieri, Mexican Badger. *L.*
Mustela nigripes, Black-footed Ferret.
Procyon (*lotor*?), Raccoon. *T.*
Procyon lotor mexicanus, Mexican Raccoon. *L.*
Bassariscus astutus flavus, Civet Cat. *L.*
Myotis velifer, Cave Bat. *L.*
Myotis californicus, Little California Bat. *L.*
Myotis thysanodes, Fringed Bat. *L.*
Myotis evotis, Long-eared Bat. *T.*
Myotis incautus, House Bat. *L.*
Myotis yumanensis, Yuma Bat. *L.*
Corynorhinus macrotis pallescens, Big-eared Bat. *L.*

BREEDING BIRDS OF UPPER SONORAN ZONE IN NEW MEXICO.

[Species marked *L.* breed also in Lower Sonoran Zone; those marked *T.* also in Transition.]

Erismatura jamaicensis, Ruddy Duck. *T.*
Querquedula cyanoptera, Cinnamon Teal. *T.*
Numenius americanus, Long-billed Curlew.
Podasocys montanus, Mountain Plover.
Callipepla squamata squamata, Scaled Quail. *L.*
Cyrtonyx montezumae mearnsi, Mearns's Quail.
Zenaidura macroura marginella, Mourning Dove. *L.*
Strix occidentalis huachucae, Huachuca Spotted Owl.
Otus asio cineraceus, Mexican Screech Owl.
Otus asio aikeni, Aiken's Screech Owl.
Speotyto cunicularia hypugaea, Burrowing Owl. *L.*
Coccyzus americanus occidentalis, California Cuckoo. *L.*
Dryobates arizonae, Arizona Woodpecker.
Phalaenoptilus nuttalli nuttalli, Poor-will.

BREEDING BIRDS OF UPPER SONORAN ZONE IN NEW MEXICO—continued.

Chordeiles virginianus henryi, Western Nighthawk. *T.*

Aëronautes melanoleucus, White-throated Swift. *T.*

Tyrannus tyrannus, Kingbird. *T.*

Tyrannus verticalis, Arkansas Kingbird.

Myiarchus cinerascens cinerascens, Ash-throated Flycatcher. *L.*

Empidonax fulvifrons pygmaeus, Buff-breasted Flycatcher.

Otocoris alpestris occidentalis, Montezuma Horned Lark.

Aphelocoma woodhousei, Woodhouse's Jay.

Corvus corax sinuatus, Raven. *T.*

Corvus brachyrhynchos hesperis, Western Crow. *T.*

Cyanocephalus cyanocephalus, Piñon Jay.

Xanthocephalus xanthocephalus, Yellow-headed Blackbird. *T.*

Agelaius phoeniceus neutralis, San Diego Redwing. *T.*

Sturnella neglecta, Western Meadowlark. *T.*

Icterus bullocki, Bullock's Oriole. *L.*

Carpodacus mexicanus frontalis, House Finch. *L.*

Astragalinus psaltria psaltria, Arkansas Goldfinch. *L.*

Chondestes grammacus strigatus, Western Lark Sparrow. *L.*

Spizella wortheni, Worthen's Sparrow.

Spizella atrogularis, Black-chinned Sparrow.

Amphispiza nevadensis (breeding?), Sage Sparrow.

Aimophila ruficeps scotti, Scott's Sparrow.

Pipilo fuscus mesoleucus, Cañon Towhee.

Passerina amoena, Lazuli Bunting.

Calamospiza melanocorys, Lark Bunting.

Piranga rubra cooperi, Cooper's Tanager.

Lanius ludovicianus excubitorides, White-rumped Shrike.

Dendroica aestiva aestiva, Yellow Warbler. *T.*

Geothlypis trichas occidentalis, Western Yellowthroat. *L.*

Icteria virens longicauda, Long-tailed Chat. *L.*

Dumetella carolinensis, Catbird.

Salpinctes obsoletus obsoletus, Rock Wren. *T.*

Thryomanes bewicki bairdi, Baird's Wren.

Telmatodytes palustris plesius, Western Marsh Wren.

Baeolophus inornatus griseus, Gray Titmouse.

Baeolophus wollweberi, Bridled Titmouse.

Psaltriparus plumbeus, Lead-colored Bush Tit.

Psaltriparus melanotis lloydi, Lloyd's Bush Tit.

Polioptila caerulea obscura, Western Gnatcatcher. *L.*

REPTILES OF UPPER SONORAN ZONE IN NEW MEXICO.

[Species marked *L.* occur also in Lower Sonoran Zone; those marked *T.*, also in Transition.]

Turtles.

Chrysemys cinerea belli, Bell's Terrapin. *L.*

Chrysemys elegans, Cumberland Terrapin. *L.*

Terrapena ornata, Painted Box Turtle. *L.*

Lizards.

Crotaphytus collaris, Collared Lizard.

Crotaphytus collaris baileyi, Western Collared Lizard.

Holbrookia maculata.

Holbrookia approximans.

Holbrookia flavilenta.

Uta levis, Light Sand Lizard.

Uta ornata, Painted Sand Lizard.

Sceloporus consobrinus, Scaly Fence Lizard.

Sceloporus poinsetti, Poinsett Lizard.

Sceloporus jarrovi, Yarrow's Lizard.

Phrynosoma hernandesi, Short-horned Lizard. *T.*

Phrynosoma ornatissimum, Desert-horned Lizard.

Gerrhonotus nobilis, Large Gerrhonotus.

Cnemidophorus grahami, Graham Whip-tailed Lizard.

Eumeces obsoletus, Large Skink.

Eumeces guttulatus, Small Skink.

Eumeces multivirgatus, Many-lined Skink.

REPTILES OF UPPER SONORAN ZONE IN NEW MEXICO—continued.

Snakes.

Thamnophis eques, Brown Garter Snake.
Thamnophis macrostemma, Mexican Garter Snake.
Thamnophis ordinoides elegans, Western Garter Snake. *T.*
Thamnophis sirtalis parietalis, Red-barred Garter Snake.
Bascanion flagellum frenatum, Coachwhip Snake.
Bascanion taeniatum, Mountain Racer.
Pituophis sayi, Prairie Bull Snake.
Pituophis catenifer deserticola, Desert Bull Snake.
Liopeltis vernalis, Smooth Green Snake.
Lampropeltis triangulum amaurus, Milk Snake.
Heterodon nasicus, Hognosed Snake. *L.*
Crotalus confluentus, Plains Rattlesnake.
Crotalus molossus, Black-tailed Rattlesnake.
Crotalus lepidus, Kennicott's Rattlesnake.

AMPHIBIANS OF UPPER SONORAN ZONE IN NEW MEXICO.

[Species marked *L.* occur also in the Lower Sonoran Zone.]

Toads and Frogs.

Scaphiopus hammondi, Spadefoot Toad.
Scaphiopus hammondi bombifrons, Plains Spadefoot.
Bufo cognatus, Toad. *L.*
Bufo punctatus, Spotted Toad. *L.*
Bufo woodhousii, Common Toad. *L.*
Hyla arenicolor, Desert Tree Frog. *L.*
Hyla eximia.
Rana pipiens, Leopard Frog. *L.*

Salamanders.

Ambystoma tigrinum, Tiger Salamander. *L.*
Ambystoma trisruptum.
Spelerpes multiplicatus, Many-ribbed Triton.[1]

PLANTS OF UPPER SONORAN ZONE IN NEW MEXICO.

[Species marked *L.* occur also in Lower Sonoran Zone; those marked *T.*, also in Transition.]

Trees, shrubs, and herbaceous plants.

Pinus edulis, Nut Pine, Pinyon.
Pinus cembroides, Mexican Nut Pine.
Juniperus monosperma, One-seeded Juniper.
Juniperus utahensis, Utah Juniper.
Juniperus megalocarpa, Large-fruited Juniper.
Juniperus pachyphloea, Checker-barked Juniper.
Juniperus scopulorum, Silky Juniper. *T.*
Quercus grisea, Gray Live Oak.
Quercus arizonica, Arizona Gray Live Oak.
Quercus emoryi, Black Live Oak.
Quercus undulata, Scrub Oak.
Quercus oblongifolia, Oblong-leaf Oak.
Quercus pungens, Shin Oak.
Quercus acuminata, Chinquapin Oak.
Juglans major, Arizona Walnut.
Platanus wrighti, Arizona Sycamore.
Populus wislizeni, Rio Grande Cottonwood. *L.*
Populus acuminata, Lance-leaf Cottonwood.
Salix wrighti, Wright Willow. *L.*
Salix nigra, Black Willow.
Salix exigua, Gray Willow.
Alnus oblongifolia, Long-leaved Alder.
Negundo aceroides, Box Elder.
Fraxinus velutina, Leatherleaf Ash.
Fraxinus cuspidata, Fringe Ash.
Adelia neomexicana, Forestiera.
Celtis reticulata, Hackberry.
Morus microphylla, Small-leaf Mulberry.
Cercocarpus parvifolius, Small-leaf Mountain Mahogany.
Cercocarpus paucidentatus, Southern Mountain Mahogany.
Cowania mexicana, Cliff Rose.

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[1] Collected in the Jemez Mountains by Prof. Junius Henderson. Specimen No. 42921, U. S. Nat. Mus. Coll. First record for New Mexico.

PLANTS OF UPPER SONORAN ZONE IN NEW MEXICO—continued.

Trees, shrubs, and herbaceous plants—Continued.

Fallugia paradoxa, Poniel, "Apache Plume."
Fallugia paradoxa acuminata, Poniel, "Apache Plume." *L.*
Amelanchier bakeri, Juneberry, Service Berry.
Schmaltzia trilobata, Skunk Bush.
Schmaltzia pumila, Velvet-leaved Sumac.
Schmaltzia glabra, Smooth Sumac. *T.*
Ribes cereum, Red Currant. *T.*
Ribes longiflorum, Flowering Currant.
Choisya dumosa, Star-leaf.
Farsellesia spinescens.
Ceanothus greggi.
Berberis haematocarpa, Red Barberry.
Berberis fremonti, Blue Barberry.
Berberis wilcoxi, Wilcox Barberry.
Garrya wrighti, Silk-tassel Bush.
Garrya goldmani, Silk-tassel Bush.
Philadelphus microphyllus, Syringa Bush.
Philadelphus argyrocalyx, Syringa Bush.
Fendlera rupicola.
Arctostaphylos pungens, Manzanita.
Lepargyrea argentea, Buffalo Berry.
Ptelea angustifolia, Narrow-leaved Trefoil.
Vitis arizonica, Wild Grape. *T.*
Ephedra viridis, Green Joint Fir.
Lycium pallidum, Pale Boxthorn.
Sarcobatus vermiculatus, Greasebrush. *L.*
Atriplex canescens, Salt Bush, Gray Shadscale. *L.*
Atriplex confertifolia, Salt Bush.
Atriplex wrighti, Salt Bush.
Atriplex powelli, Salt Bush.
Atriplex argentea, Salt Bush.
Eurotia lanata, White Sage, Winter Fat.
Eriogonum hieracifolium, Eriogonum.
Eriogonum polycladon, Eriogonum.
Eriogonum densum, Eriogonum.
Eriogonum cernuum, Eriogonum.
Eriogonum subreniforme, Eriogonum.
Eriogonum wrighti, Eriogonum.
Eriogonum divergens, Eriogonum.
Croton texensis, Texas Croton.
Croton fruticulosus.
Stillingia linearifolia, Spurge.
Argemone hispida, Prickly Poppy.
Argemone intermedia, Prickly Poppy.
Argemone platyceros, Prickly Poppy.
Mimosa biuncifera, Cat's-claw.
Mimosa fragrans, Fragrant Cat's-claw.
Mimosa dysocarpa, Cat's-claw.
Mimosa lemmoni, Cat's-claw.
Acacia cuspidata, Toothed Acacia.
Acuan jamesi, James Acacia. *L.*
Chamaecrista leptadenia.
Calliandra humilis. *T.*
Hoffmanseggia drapanocarpa. *L.*
Parosela calycosa, Dalea.
Parosela enneandra, Dalea.
Parosela brachystachys, Dalea.
Parosela jamesi, Dalea.
Parosela grayi, Dalea. *L.*
Parosela ardiae, Dalea. *L.*
Psoralea micrantha, Small-flowered Psoralea.
Psoralea tenuiflora, Narrow-flowered Psoralea.
Lupinus pusillus, Small Lupine.
Lupinus aduncus, Lupine.
Lupinus dispersus, Lupine. *L.*
Lupinus brevicaulis, Lupine. *T.*
Lathyrus decaphyllus, Prairie Vetchling.
Meibomia bigelovi, Tick Trefoil.
Meibomia neomexicana, Tick Trefoil.
Meibomia grahami, Tick Trefoil.
Dolicholus texensis.
Galactia wrighti, Milk Pea.
Phaseolus acutifolius, Wild Bean.
Phaseolus macropoides, Wild Bean.
Phaseolus angustissimus, Wild Bean. *L.*
Cologania pulchella.
Petalostemon purpureum, Violet Prairie Clover.
Petalostemon tenuifolium, Silky Prairie Clover. *T.*
Petalostemon oligophyllum, White Prairie Clover. *T.*
Parryella filifolia.
Astragalus diphysus, Milk Vetch.
Astragalus nuttallianus, Milk Vetch.
Astragalus bigelovi, Milk Vetch.
Astragalus praelongus, Milk Vetch.
Astragalus pattersoni, Milk Vetch.
Astragalus missouriensis, Milk Vetch.
Astragalus shortianus, Milk Vetch.
Astragalus amphioxus, Milk Vetch.
Astragalus ceramicus, Milk Vetch.
Astragalus thurberi, Milk Vetch.
Astragalus allochrous, Milk Vetch.
Astragalus sonorae, Milk Vetch.
Krameria secundiflora. *L.*
Artemisia tridentata, Black Sagebrush. *T.*
Artemisia arbuscula, Brown Sagebrush. *T.*

PLANTS OF UPPER SONORAN ZONE IN NEW MEXICO—continued.

Trees, shrubs, and herbaceous plants—Continued.

Chrysothamnus graveolens, Rabbit Brush.
Chrysothamnus linifolius, Rabbit Brush.
Chrysothamnus stenophyllus, Rabbit Brush.
Chrysothamnus bigelovi, Rabbit Brush.
Chrysoma laricifolia, Rabbit Brush.
Isocoma heterophylla, Rabbit Brush. *L.*
Gutierrezia tenuis, Rabbit Brush.
Gutierrezia longifolia, Rabbit Brush.
Gutierrezia filifolia, Rabbit Brush.
Tetradymia inermis, Rabbit Brush.
Crassina grandiflora.
Ximenesia exauriculata.
Opuntia arborescens, Tree Cactus, Cane Cactus. *L.*
Opuntia spinosior, Arizona Tree Cactus.
Opuntia davisi, Davis Bush Cactus.
Opuntia whipplei, Whipple Bush Cactus.
Opuntia clavata, Creeping Cactus.
Opuntia sphaerocarpa, Dwarf Cactus.
Opuntia trichophora, Dwarf Cactus.
Opuntia polyacantha, Dwarf Cactus.
Opuntia camanchica, Camanche Prickly Pear.
Opuntia tenuispina, Slender-spined Prickly Pear.
Opuntia cymochila, Yellow-spined Prickly Pear. *L.*
Opuntia balli, Ball Prickly Pear.
Opuntia engelmanni, Engelmann Prickly Pear.
Opuntia dillei, Dille Prickly Pear.
Opuntia wootoni, Wooton Prickly Pear.
Opuntia phaeacantha, Brown-spined Prickly Pear.
Mamillaria lasiacantha, Pincushion Cactus.
Mamillaria meiacantha, Pincushion Cactus.
Mamillaria heyderi, Pincushion Cactus. *L.*
Mamillaria dasyacantha, Pincushion Cactus.
Mamillaria radiosa, Pincushion Cactus. *T.*
Echinocereus viridiflorus, Green-flowered Petaya.
Echinocereus fendleri, Purple-flowered Petaya.
Echinocereus triglochidiatus. *L.*
Echinocereus paucispinus, Few-spined Petalla.
Echinocereus coccineus, Red-flowered Petalla. *T.*
Agave applanata, Guadalupe Century Plant.
Agave palmeri, Palmer Century Plant.
Agave parryi, Parry Century Plant.
Nolina greenei, Greene's Beargrass.
Nolina microcarpa, Small-seeded Beargrass.
Yucca baccata, Banana-fruited Yucca.
Yucca glauca, Narrow-leaved Low Yucca.
Yucca schotti, Wide-leaved Tree Yucca.

Grasses.

Hilaria jamesi, Galleta Grass.
Andropogon halli, Blue Stem.
Bulbilis dactyloides, Buffalo Grass.
Bouteloua curtipendula, Tall Grama Grass. *L.*
Bouteloua hirsuta, Hairy Grama Grass. *T.*
Bouteloua oligostachya, Blue Grama Grass.
Bouteloua bromoides, Large Mesquite Grass.
Oryzopsis micrantha, Rice Grass.
Muhlenbergia vaseyana, Dropseed Grass.
Muhlenbergia pungens, Dropseed Grass. *L.*
Muhlenbergia distichophylla, Dropseed Grass.
Muhlenbergia mexicana, Dropseed Grass. *L.*
Muhlenbergia monticola, Dropseed Grass.
Muhlenbergia arenicola, Dropseed Grass. *L.*
Muhlenbergia affinis, Dropseed Grass.
Muhlenbergia acuminata, Dropseed Grass.
Stipa neomexicana, Feather Grass.
Stipa comata, Feather Grass.
Stipa fimbriata, Feather Grass. *T.*
Stipa editorum, Feather Grass.
Erioneuron pilosum.
Eragrostis lugens, Eragrostis.
Eragrostis trichodes, Eragrostis.
Eragrostis oxylepis, Eragrostis.
Eragrostis sessilispica, Eragrostis.
Eragrostis major, Meadow Grass (probably always introduced).
Nazia aliena (introduced). *L.*
Sporobolus cryptandrus, Bunch Grass.

PLANTS OF UPPER SONORAN ZONE IN NEW MEXICO—continued.

Grasses—Continued.

Epicampes rigens.
Eatonia obtusata, Eaton Grass.
Puccinellia distans, Meadow Grass.
Festuca octoflora, Fescue Grass.
Agropyron spicatum, Wheat Grass.
Panicum arizonicum, Panic Grass. *L.*
Panicum halli, Panic Grass. *L.*
Panicum pampinosum, Panic Grass.
Chloris verticillata, Prairie Chloris. *L.*
Trichloris fasciculata. *L.*
Aristida wrighti, Poverty Grass.
Aristida fendleriana, Poverty Grass.
Aristida purpurea, Poverty Grass. *L.*
Aristida cirrhatus, Poverty Grass. *L.*
Eriocoma cuspidata, Indian Millet. *L.*
Schizachyrium scoparium, Broom Grass. *T.*
Poa fendleriana, Spear Grass, Mutton Grass. *T.*
Elymus canadensis, Wild Rye. *T.*
Sitanion longifolium. *T.*
Sitanion pubiflorum, Lyme Grass.

UPPER SONORAN ZONE CROPS.

In New Mexico, Upper Sonoran is the principal zone of small grains, including wheat, oats, rye, barley, and emmer. Under irrigation early varieties of corn succeed in most parts of the zone. Sorghum, kafir corn, milo maize, and millet are especially adapted to the Upper Sonoran. White potatoes mature to great perfection in suitable soils, alfalfa yields two or three good crops in a season, and sugar beets give a good yield and show a high percentage of sugar. Squashes, beans, peas, and a great variety of garden vegetables thrive. Fruits of many kinds reach their greatest perfection in the Great Basin division of the zone; but, owing to the elevation and aridity and consequent lack of deep snows to delay the flowering time in spring, the late frosts render unfruitful many of the early-flowering varieties and reduce the list of fruits that can be safely recommended to the late-flowering, hardy, or frost-resistant varieties.

The North and Central Utah Experiment Stations at Logan and Lehi, Utah, are in this division of the zone and have much the same climate and set of native species. The reports of crops and fruits tested at these stations apply fairly well to this part of the zone in New Mexico, but there would be some advantages in substations for testing crops in both the Great Basin and Great Plains subdivisions of the zone in western and eastern New Mexico.

APPLES.

Upper Sonoran is the great apple zone of the Rocky Mountain region, and many valleys within this zone in Utah, Colorado, and New Mexico have become famous for the quality and flavor of this fruit. The varieties recommended by the American Pomological Society as tested in their district No. 12 (including Utah, most of Colorado, and the northern third of New Mexico and Arizona) are suited to practically all Upper Sonoran Zone localities in New Mexico except the Great Plains division.[1] The following list contains only the varieties classed by the society as *highly successful*, and would have been much longer if the *successful* and *promising* varieties had been included:

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[1] Fruits Recommended by the American Pomological Society for Cultivation in the Various Sections of the United States and Canada, Bull. 151, Bur. Plant Industry, U. S. Dept. Agric., pp. 14-22, 1909.

Ben Davis.
Chenango.
Early Harvest.
Gano.
Grimes.
Jonathan.
Maiden Blush.
Missouri.
Oldenburg.
Rambo.
Red June.
Rhode Island Greening.
Rome Beauty.
Summer Pearmain.
Wealthy.
White Pearmain.
Winesap.
Wolf River.
Yellow Bellflower.
Yellow Transparent.
York Imperial.
Hyslop (crab apple).
Transcendent (crab apple).

All but six of these were recommended for the arid Upper Sonoran area by Dr. Merriam.[1]

Most of the preceding and a few additional varieties are included in the lists reported by Prof. Garcia as satisfactory in purely Upper Sonoran valleys in northwestern New Mexico.[2] Those additional to the previous list are:

Arkansas Black.
Cooper's White.
Janet.
Arkansas (Mammoth Black Twig).
Greening.
Snow.
Smith's Cider.

QUINCES.

The following quinces are recommended by the American Pomological Society as *successful* in their district No. 12:[3]

Champion.
Missouri.
Orange.

PEARS.

Some of the most delicious pears I ever tasted were raised in the Upper Sonoran Zone of New Mexico, where they seem to bear well and reach great perfection. The varieties listed as *highly successful* are:[4]

Anjou.
Bartlett.
Louise.
Seckel.
Winter Nelis.

CHERRIES.

Upper Sonoran is the zone of cherries in the Rocky Mountain region. Except where the flowers are endangered by late spring frosts, many of the standard varieties bear well and mature excellent fruit. Of these, the sour cherries are considered most reliable. Those reported most favorably to the State horticulturist from Upper Sonoran localities are as follows:[5]

Early Richmond.
English Morello.
Montmorency.

These and the Napoleon are listed by the American Pomological Society as *highly successful*.[6] Others listed as *known to succeed* are:

Knight.
Oxheart.
Tartarian.
Windsor.
Choisy.
Dyehouse.
Large Montmorency.
Late Duke.
May Duke.
Ostheim.
Royal Duke.

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[1] Life Zones and Crop Zones, Bull. 10, Biol. Survey, pp. 37–38 and 59–60, 1898.

[2] Garcia, F., Apple Culture under Irrigation, Bull. 75, New Mex. Agric. Exp. Sta., p. 28, 1910.

[3] Bull. 151, Bur. Plant Industry, p. 47, 1909.

[4] Ibid., pp. 40–41.

[5] Garcia, F., Orchard Notes, Bull. 39, New Mex. Agric. Exp. Sta., p. 111, 1901.

[6] Bull. 151, Bur. Plant Industry, pp. 26–27, 1909.

NECTARINES.

In the Jemez Canyon, at about the middle of the Upper Sonoran Zone, I have eaten delicious nectarines from thrifty trees, but could not learn the variety. The American Pomological Society lists four varieties *known to succeed* in this zone:

Boston.
Golden.
New White.
Snow Flake.

PEACHES.

Peach trees are generally thrifty and sound throughout the Upper Sonoran Zone, but their tendency is to blossom so early that fruit is rarely produced, except in unusually protected localities. When they do bear, the fruit is of excellent quality and flavor, but until better methods of controlling the flowering time are devised, it is not safe to recommend even the hardy varieties.

APRICOTS.

In some years there is a fair crop of seedling apricots in Upper Sonoran Zone localities in New Mexico, but usually the flowers come out so early as to be killed by the frost. It is doubtful if any variety would prove a safe crop in this zone except in peculiarly protected spots. Still, for the Upper Sonoran area of Colorado, Utah, and northern Arizona and New Mexico (district No. 12) the American Pomological Society[1] recommends one variety (Moorpark) as *highly successful* and six others as *known to succeed*:

Breda.
Early Golden.
Newcastle.
Orange.
Peach.
Royal.

GRAPES.

The Mission grape is raised and does well in many of the warmer Upper Sonoran valleys of New Mexico. Other varieties recommended by the American Pomological Society for district No. 12 should be equally adapted to all but the Plains division of Upper Sonoran Zone in New Mexico. Those listed as *highly successful* are:[2]

Delaware.
Concord.
Moore.
Niagara.
Worden.

Varieties *known to succeed:*

Agawam.
Brighton.
Duchess.
Goethe.
Isabella.
Ives.
Lindley.
Prentiss.
Salem.
Wilder.

CURRANTS.

Currants listed as *highly successful* by the American Pomological Society are:[3]

Cherry.
Fay.
Red Dutch.
Versaillaise.
White Dutch.

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[1] Bul. 151, Bur. Plant Industry, p. 23, 1909.

[2] Ibid., pp. 30-33.

[3] Ibid., p. 28.

Those listed as *known to succeed* are:

Albert.
Holland.
London.
Victoria.
White Grape.

GOOSEBERRIES.

Gooseberries listed by the American Pomological Society as *highly successful* are:[1]

Downing.
Houghton.
Josselyn.
Smith.

Those *known to succeed* are:

Berkeley.
Champion.
Chautauqua.
Industry.
Oregon.
Whitesmith.

BLACKBERRIES.

Blackberries listed by the American Pomological Society as *highly successful* (l. c., pp. 24, 25) are:

Britton.
Minnewaska.

Those *known to succeed* are:

Acme.
Early Harvest.
Erie.
Kittatinny.
Lawton.
Stone.
Wilson.

DEWBERRIES.

The only dewberry listed by the American Pomological Society as *highly successful* is the Lucretia.

RASPBERRIES.

Raspberries listed by the American Pomological Society as *highly successful* (l. c., pp. 48, 49) are:

Gregg.
Kansas.
Cuthbert.
Marlboro.

Those *known to succeed* are:

Columbian.
Shaffer.
McCormick.
Nemaha.
Ohio.
Palmer.
Souhegan.
Tyler.
Brandywine.
Golden.
Loudon.
Turner.

STRAWBERRIES.

Strawberries listed by the American Pomological Society as *highly successful* (l. c., pp. 50, 51) are:

Bederwood.
Crescent.
Gandy.
Haverland.

Those *known to succeed* are:

Brandywine.
Captain Jack.
Cumberland.
Downing.
Glen Mary.
Jessie.
Parker Earle.
Saunders.
Sharpless.
Warfield.
Wilson.
Woolverton.

TRANSITION ZONE.

The Transition Zone in New Mexico covers the middle slopes of the higher mountains and the upper slopes or tops of most of the lower ranges. Its area is about 10,000 square miles. Approximately it runs from 7,000 to 8,500 feet on northeast slopes and from 8,000 to 9,500 on southwest slopes, but almost every range of mountains shows some variation. Owing to the more elevated base level in the northern part of the State (6,000 to 7,000 feet), the effect of latitude is more than counterbalanced, and the borders of the zone instead of being lower are pushed higher than in the southern part, where the base level is mainly below 5,000 feet. As is well known, a broad elevated plateau or valley, acting as a warm radiating surface, raises the zones. This is one of the disturbing factors which interrupt the natural uniform depression of the zones toward the north.

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[1] Bull. 151, Bur. Plant Industry, p. 29, 1909.

In places the Transition Zone covers broad mesas, as over the tops of the Chusca and Zuni Mountains and along the sides of most of the higher ranges. It is the zone of the principal timber tree of the State, the yellow pine, which forms extensive forests of great value and beauty. These forests are almost invariably open, clean, and grassy and are valuable for grazing as well as for lumber. On some mesa tops where both trees and bushes are absent the zone is less clearly marked and can be determined only by inconspicuous species and by the absence of those of the Sonoran Zone. Such an area is found on top of Chaca Mesa, where the absence of junipers and nut pines and the presence of a broad expanse of sagebrush plains on northerly slopes above the 7,000-foot contour indicate Transition Zone. Some high valleys also, such as Moreno Valley in the Sangre de Cristo Mountains, and Valle San Antonio, Valle Grande, and Valle Santa Rosa in the Jemez Mountains, while treeless, belong to the Transition Zone.

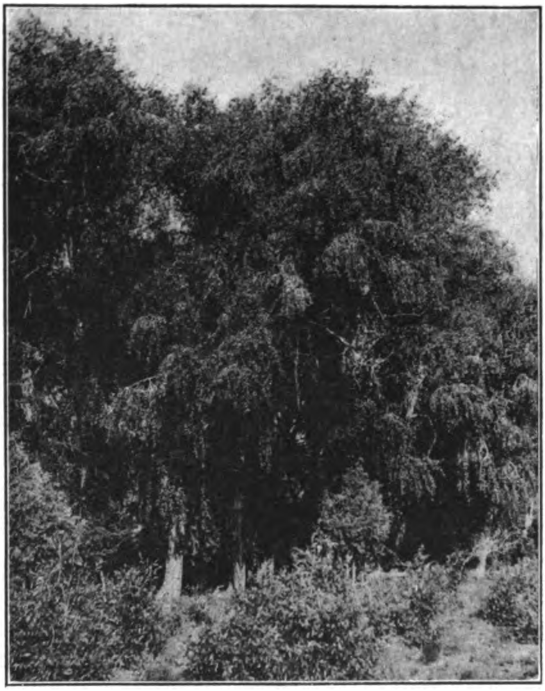

FIG. 3.—Narrow-leaved cottonwood (*Populus angustifolia*), a beautiful Transition Zone tree of the stream valleys.

Farming is carried on in some of these valleys and good crops of potatoes, grain, and garden vegetables are raised for home use, usually, however, in connection with stock ranches, for which the valleys are especially favorable. There are usually sufficient rain and snow for good crops without irrigation if dry-farming methods are applied in the preparation and cultivation of the soil, and in many places there are streams which may be used for irrigation.

The Transition Zone is extremely uniform in climate and species throughout New Mexico, as it is throughout most of the Rocky Mountain States. Even the isolated Transition Zone areas (practically islands) of the Sacramento, Manzano, Sandia, San Mateo, Zuni, Chusca, Mogollon, Mimbres, and Burro Mountains have few species not common to the Transition fauna and flora of the main mass of the Rocky Mountains.

Restricted areas in the Animas, Peloncillo, and Big Hatchet Mountains, near the southwest corner of the State, bring in many species from the Mexican tableland, and a few of these, especially the birds, stray across to the Mogollon Mountains.

MAMMALS OF TRANSITION ZONE IN NEW MEXICO.

[Species marked *U.* occur also in the Upper Sonoran Zone; those marked *C.*, also in the Canadian.]

Cervus merriami, Merriam Elk. *C.*
Odocoileus hemionus, Mule Deer. *U. C.*
Sciurus aberti, Abert Squirrel.
Sciurus aberti mimus, Tuft-eared Squirrel.
Eutamias cinereicollis, Gray-collared Chipmunk.
Eutamias cinereicollis cinereus, Gray-sided Chipmunk.
Eutamias cinereicollis canipes, Gray-footed Chipmunk.
Eutamias quadrivittatus, Rocky Mountain Chipmunk.
Eutamias quadrivittatus hopiensis, Hopi Chipmunk.
Callospermophilus lateralis, Say Ground Squirrel. *C.*
Callospermophilus lateralis arizonensis, Arizona Ground Squirrel.
Cynomys gunnisoni, Gray-tailed Prairie Dog. *U.*
Neotoma mexicana, Mexican Wood Rat.
Neotoma mexicana fallax, Colorado Wood Rat.
Neotoma pinetorum, San Francisco Mountain Wood Rat.
Neotoma cinerea orolestes, Colorado Bushy-tailed Wood Rat.
Castor canadensis frondator, Broad-tailed Beaver. *U.*
Microtus pennsylvanicus modestus, Colorado Meadow Mouse. *U.*
Microtus mogollonensis, Mogollon Meadow Mouse.
Microtus mexicanus guadalupensis, Guadalupe Meadow Mouse.
Zapus luteus, Jumping Mouse. *U.*
Erethizon epixanthum, Yellow-haired Porcupine. *C.*
Erethizon epixanthum couesi, Arizona Porcupine.
Thomomys fossor, Mountain Pocket Gopher. *C.*
Thomomys fulvus, Fulvous Pocket Gopher. *C.*
Thomomys aureus apache, Apache Pocket Gopher.
Lepus campestris, White-tailed Jack Rabbit.
Sylvilagus floridanus holzneri, Holzner Cottontail.
Sylvilagus cognatus, Manzano Mountain Cottontail.
Sylvilagus nuttalli pinetis, Rocky Mountain Cottontail.
Felis hippolestes, Rocky Mountain Mountain Lion. *C.*
Felis hippolestes aztecus, Mexican Mountain Lion. *U.*
Lynx uinta, Mountain Bobcat.
Canis mexicanus, Mexican Wolf. *U.*
Canis lestes, Mountain Coyote.
Taxidea taxus, Badger. *C.*
Mustela arizonensis, Arizona Weasel. *C.*
Lutra (*canadensis*?), Otter.
Lutreola, Mink. *C.*

MAMMALS OF TRANSITION ZONE IN NEW MEXICO—continued.

Mephitis estor, Arizona Skunk. *U.*
Procyon lotor, Raccoon.
Ursus americanus ambliceps, Black Bear. *C.*
Ursus (*horribilis?*), Grizzly Bear. *C.*
Ursus horribilis horriaeus, Mexican Grizzly. *C.*
Eptesicus fuscus, Brown Bat. *U.*
Myotis lucifugus longicrus, Long-legged Bat. *U.*

BREEDING BIRDS OF TRANSITION ZONE IN NEW MEXICO.

[Species marked *U.* breed also in the Upper Sonoran Zone; those marked *C.*, also in the Canadian.]

Erismatura jamaicensis, Ruddy Duck. *U.*
Querquedula cyanoptera, Cinnamon Teal. *U.*
Spatula clypeata, Shoveler.
Dendragapus obscurus obscurus, Dusky Grouse. *C.*
Meleagris gallopavo merriami, Merriam's Turkey.
Columba fasciata fasciata, Band-tailed Pigeon.
Accipiter velox, Sharp-shinned Hawk. *C.*
Accipiter cooperi, Cooper's Hawk.
Otus flammeolus flammeolus, Flammulated Screech Owl.
Cryptoglaux acadica acadica, Saw-whet Owl.
Glaucidium gnoma pinicola, Pygmy Owl.
Dryobates villosus monticola, Rocky Mountain Hairy Woodpecker. *C.*
Dryobates villosus leucothorectis, White-breasted Woodpecker.
Melanerpes formicivorus formicivorus, Ant-eating Woodpecker. *U.*
Asyndesmus lewisi, Lewis's Woodpecker.
Colaptes cafer collaris, Red-shafted Flicker. *C.*
Antrostomus vociferus macromystax, Stephens's Whippoorwill.
Chordeiles virginianus henryi, Western Nighthawk. *U.*
Aëronautes melanoleucus, White-throated Swift. *U.*
Cyanolaemus clemenciae, Blue-throated Hummingbird.
Archilochus alexandri, Black-chinned Hummingbird. *U.*
Myiochanes richardsoni richardsoni, Western Wood Pewee.
Empidonax wrighti, Wright's Flycatcher.
Otocoris alpestris leucolaema, Desert Horned Lark. *U.*
Pica pica hudsonia, Black-billed Magpie.
Hesperiphona vespertina montana, Western Evening Grosbeak.
Pooecetes gramineus confinis, Western Vesper Sparrow. *U.*
Spizella passerina arizonae, Western Chipping Sparrow. *U.*
Spizella breweri, Brewer's Sparrow. *U.*
Junco phaeonotus dorsalis, Red-backed Junco. *C.*
Melospiza melodia montana, Mountain Song Sparrow.
Pipilo maculatus montanus, Spurred Towhee.
Oreospiza chlorura, Green-tailed Towhee.
Zamelodia melanocephala, Black-headed Grosbeak. *U.*
Piranga ludoviciana, Western Tanager.
Piranga hepatica, Hepatic Tanager. *U.*
Lanivireo solitarius plumbeus, Plumbeous Vireo.
Vermivora virginiae, Virginia's Warbler.
Vermivora celata celata, Orange-crowned Warbler.
Peucedramus olivaceus, Olive Warbler.
Dendroica auduboni auduboni, Audubon's Warbler. *C.*
Dendroica graciae, Grace's Warbler.
Dendroica nigrescens, Black-throated Gray Warbler.
Oporornis tolmiei, Macgillivray's Warbler. *C.*
Setophaga picta, Painted Redstart.
Cardellina rubrifrons, Red-faced Warbler.
Oreoscoptes montanus, Sage Thrasher.
Troglodytes aëdon parkmani, Western House Wren. *U.*
Sitta carolinensis nelsoni, Rocky Mountain Nuthatch.
Sitta pygmaea pygmaea, Pygmy Nuthatch.
Penthestes sclateri, Mexican Chickadee.

BREEDING BIRDS OF TRANSITION ZONE IN NEW MEXICO—continued.

Penthestes gambeli, Mountain Chickadee. *U.*
Hylocichla fuscescens salicicola, Willow Thrush.
Planesticus migratorius propinquus, Western Robin. *C.*
Sialia mexicana bairdi, Chestnut-backed Bluebird.

REPTILES OF TRANSITION ZONE.

[Species marked *U.* occur also in the Upper Sonoran Zone.]

Lizards.

Phrynosoma hernandesi, Short-horned lizard. *U.*

Snakes.

Thamnophis ordinoides elegans, Western Garter Snake. *U.*

PLANTS OF TRANSITION ZONE IN NEW MEXICO.

[Species marked *U.* occur also in the Upper Sonoran Zone; those marked *C.*, also in the Canadian Zone.]

Trees and shrubs.

Pinus scopulorum, Yellow Pine.
Pinus arizonica, Arizona Pine.
Pinus chihuahuana, Chihuahua Pine.
Pinus mayriana, Mayr Pine.
Pinus strobiformis, Mexican White Pine.
Pseudotsuga mucronata, Douglas Spruce. *C.*
Cupressus arizonica, Arizona Cypress.
Populus angustifolia, Narrow-leaved Cottonwood.
Quercus gambeli, Gambel's Oak.
Quercus venustula.
Quercus submollis.
Quercus utahensis, Utah Oak.
Quercus vreelandi, Vreeland Oak.
Quercus leptophylla, Scale-leaved Oak.
Quercus gunnisoni, Gunnison Oak.
Quercus novomexicana, New Mexico Oak.
Quercus hypoleuca, White-leaved Oak.
Quercus wilcoxi, Wilcox Oak.
Quercus reticulata, Lace-veined Oak.
Salix bebbiana, Bebb Willow. *C.*
Salix monticola, Mountain Willow.
Salix cordata watsoni, Diamond Willow.
Salix lasiandra, Western Black Willow.
Betula fontinalis, Rocky Mountain Birch.
Acer grandidentatum, Large-toothed Maple.
Acer neomexicanum, New Mexico Maple.
Robinia neomexicana, New Mexico Locust.
Prunus americana, Wild Red Plum.
Prunus melanocarpa, Choke Cherry.
Prunus salicifolia acutifolia, Black Cherry.
Arbutus arizonica, Arizona Madrone.
Rhamnus ursina, Bear Buckthorn.
Rhamnus fasciculata, Buckthorn.
Rhamnus betulaefolia, Buckthorn.
Ribes inebrians, Red Currant.
Ribes mescalerium, Mescalero Red Currant.
Grossularia pinetorum, Spiny-fruited Gooseberry.
Grossularia inermis, Purple Gooseberry.
Grossularia leptantha, Black Gooseberry.
Sericotheca dumosa.
Opulaster monogynus, Western Ninebark.
Rubus parviflorus, Thimbleberry. *C.*
Rubus neomexicanus, New Mexico Thimbleberry.
Amelanchier oreophilus, Juneberry, Service berry.
Crataegus rivularis, Thorn Apple.
Crataegus erythropoda, Thorn Apple.
Crataegus wootoniana, Thorn Apple.
Rosa fendleri, Wild Rose.
Rosa maximiliani, Wild Rose.
Berberis repens, Blue Barberry.
Berberis fendleri, Fendler Barberry.
Ceanothus fendleri, Wild Tea Bush.
Arctostaphylos uva-ursi, Bearberry.
Edwinia americana, Edwinia.
Svida riparia, River Cornel.
Symphoricarpos oreophilus, Mountain Snowberry.
Sambucus neomexicana, New Mexico Elderberry.

PLANTS OF TRANSITION ZONE IN NEW MEXICO—continued.

Herbaceous plants.

Humulus lupulus neomexicanus, Wild Hop.
Eriogonum pharanacioides, Eriogonum.
Eriogonum bakeri, Eriogonum.
Eriogonum jamesi, Eriogonum. *U.*
Eriogonum racemosum, Eriogonum. *U.*
Aquilegia elegantula, Wild Columbine.
Aquilegia formosa, Wild Columbine.
Lupinus kingi, Lupine, Bluebonnet.
Lupinus neomexicanus, Lupine.
Lupinus parviflorus, Lupine.
Thermopsis pinetorum, Yellow Thermopsis.
Vicia americana, Vetch.
Vicia pulchella, Vetch.
Vicia leucophaea, Vetch.
Lathyrus leucanthus, Wild Pea.
Phaseolus retusus, Wild Bean.
Astragalus yaquianus, Milk Vetch.
Astragalus scalaris, Milk Vetch.
Astragalus humistratus, Milk Vetch.
Astragalus rushbyi, Milk Vetch.
Astragalus bisulcatus, Milk Vetch.
Astragalus haydenianus, Milk Vetch.
Astragalus gilensis, Milk Vetch.
Juncus dudleyi, Rush, Tule.
Juncus brunescens, Rush, Tule.
Juncus parous, Rush, Tule.

Grasses.

Andropogon chrysocomus, Beard Grass.
Savastana odorata, Holy Grass.
Stipa minor, Feather Grass.
Stipa scribneri, Feather Grass.
Stipa viridula, Feather Grass.
Stipa vaseyi, Sleepy Grass.
Muhlenbergia richardsonis, Dropseed Grass.
Muhlenbergia cuspidata, Dropseed Grass. *U.*
Muhlenbergia racemosa, Dropseed Grass. *U.*
Muhlenbergia comata, Dropseed Grass.
Muhlenbergia gracilis, Dropseed Grass. *U.*
Muhlenbergia subalpina, Dropseed Grass.
Blepharoneuron tricholepis.
Agrostis exarata, Red top.
Agrostis hiemalis, Rough Hair Grass. *C.*
Bouteloua prostrata, Low Grama.
Koeleria cristata, June Grass.
Melica parviflora, Melic Grass.
Poa annua, Annual Meadow Grass.
Poa occidentalis, Western Bluegrass.
Poa pratensis, Kentucky Bluegrass.
Poa longipedunculata, Spear Grass.
Poa bigelovi, Spear Grass. *U.*
Panicularia nervata, Manna Grass.
Bromus polyanthus, Brome Grass, Chess.
Bromus lanatipes, Brome Grass.
Bromus frondosus, Bluegrass. *U.*
Bromus porteri, Brome Grass.
Bromus richardsoni, Brome Grass. *C.*
Sitanion molle, Lyme Grass.
Alopecurus geniculatus, Foxtail.
Sorghastrum nutans, Indian Grass. *U.*
Panicum bulbosum, Panic Grass. *U.*
Panicum plenum, Panic Grass. *U.*
Eragrostis neomexicana, New Mexico Eragrostis. *U.*
Agropyron smithi, Wheat Grass.
Agropyron arizonicum, Arizona Wheat Grass. *U.*
Agropyron pseudorepens, Wheat Grass. *C.*

CANADIAN ZONE.

The Canadian Zone covers most of the higher parts of the mountains and extends on cold slopes approximately from 8,500 to 11,000 feet and on warm slopes from 9,500 to 12,000 feet, varying, however, as much as 1,000 feet, according to local conditions in different ranges. Its area is estimated at approximately 2,000 square miles, lying generally in narrow and very irregular strips.[1] The largest continuous area lies on the Sangre de Cristo (the main range of the Rockies east of the Rio Grande), and there are less extensive areas on the San Juan, Jemez, Sacramento, and Mogollon Mountains, and comparatively restricted areas on the Mount Taylor, Zuni, Chusca, Datil, San Francisco, Mimbres, Magdalena, San Mateo, Manzano, Sandia, Capitan, and Raton ranges. There is a trace also in the Animas Mountains and on some of the higher buttes and isolated peaks.

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[1] In this more than in the lower zones the outlines are generalized on the zone map.

The zone is densely forested with spruce, balsam, and aspens, except in areas that have been burned, and even these quickly produce fresh growth, usually of aspens followed by conifers. In the midst of an arid region it is a humid zone, catching the maximum fall of rain and snow and holding the deep snows until late spring. Even in midsummer great banks of snow remain on shaded slopes among the trees, and long after they have disappeared the mellow soil of the mountain basins is saturated with snow water. During the summer there are also frequent, often daily, showers of rain and hail. The humidity of the zone is its greatest protection from forest fires, but in dry seasons destructive fires are frequent. Throughout the summer months it is a zone of cool crisp air and occasional frosty nights, which result in the exclusion of lower zone plants and of practically all crops.

The timber of the zone consists mainly of slender spruces, firs, and aspens, usually growing on elevated slopes difficult of access. It is of comparatively little commercial value, but locally it is valuable for mining timbers and eventually will have other uses for which its careful conservation is important. Its greatest and ever-increasing value, however, lies in the protection it affords the water supply for the surrounding agricultural valleys. Although a zone with little agriculture of its own, it is the fountain head of the agricultural wealth of the surrounding country.

The lower edge of the zone is generally sharply marked and easily recognized, but the upper edge blends almost insensibly with the narrow border of Hudsonian, which in these mountains forms but a minor division of the Boreal Zone.

MAMMALS OF THE CANADIAN ZONE IN NEW MEXICO.

[Species marked *T.* occur also in the Transition Zone; those marked *H.*, also in the Hudsonian Zone.]

Cervus canadensis, Elk. *T.*
Cervus merriami, Merriam Elk. *T.*
Odocoileus hemionus, Mule Deer. *T.*
Sciurus fremonti, Colorado Spruce Squirrel.
Sciurus fremonti mogollonensis, Arizona Spruce Squirrel.
Sciurus fremonti lychnuchus, White Mountain Spruce Squirrel.
Eutamias amoenus operarius, Colorado Chipmunk.
Callospermophilus lateralis, Say Ground Squirrel. *T.*
Marmota flaviventer, Rocky Mountain Woodchuck. *H.*
Peromyscus maniculatus rufinus, Rusty White-footed Mouse. *T.*
Phenacomys orophilus, Mountain Lemming Mouse.
Evotomys gapperi galei, Gale Red-backed Mouse.

MAMMALS OF THE CANADIAN ZONE IN NEW MEXICO—continued.

Evotomys limitis, Southern Red-backed Mouse.
Microtus mordax, Rocky Mountain Meadow Mouse.
Microtus nanus, Dwarf Meadow Mouse.
Erethizon epixanthum, Yellow-haired Porcupine. *T.*
Thomomys fossor, Mountain Pocket Gopher. *T.*
Lepus bairdi, Snowshoe Rabbit.
Lynx canadensis, Canada Lynx.
Vulpes fulva macroura, Mountain Red Fox.
Mustela arizonensis, Arizona Weasel. *T.*
Mustela streatori leptus, Dwarf Weasel.
Martes caurina origines, Marten.
Ursus americanus amblyceps, Black Bear. *T.*
Sorex palustris navigator, Water Shrew.
Sorex obscurus, Dusky Shrew. *H.*
Sorex obscurus neomexicanus, New Mexico Shrew.
Sorex vagrans monticola, Mountain Shrew.
Sorex personatus, Masked Shrew. *H.*
Nycteris cinerea, Hoary Bat.
Lasionycteris noctivagans, Silver-haired Bat.

BREEDING BIRDS OF THE CANADIAN ZONE IN NEW MEXICO.

[Species marked *T.* breed also in the Transition Zone; those marked *H.*, also in the Hudsonian Zone.]

Mergus americanus, Merganser. *T.*
Dendragapus obscurus obscurus, Dusky Grouse. *T.*
Astur atricapillus striatulus,[1] Western Goshawk.
Picoides americanus dorsalis, Alpine Three-toed Woodpecker. *H.*
Sphyrapicus varius nuchalis, Red-naped Sapsucker. *T.*
Sphyrapicus thyroideus, Williamson's Sapsucker. *T.*
Selasphorus platycercus, Broad-tailed Hummingbird. *T.*
Stellula calliope,[1] Calliope Hummingbird. *T.*
Nuttallornis borealis, Olive-sided Flycatcher.
Empidonax difficilis difficilis, Western Flycatcher. *T.*
Cyanocitta stelleri diademata, Long-crested Jay. *T.*
Perisoreus canadensis capitalis, Rocky Mountain Jay. *H.*
Carpodacus cassini, Cassin's Purple Finch.
Loxia curvirostra stricklandi, Mexican Crossbill. *T.*
Spinus pinus, Pine Siskin.
Zonotrichia leucophrys leucophrys, White-crowned Sparrow. *H.*
Junco phaeonotus caniceps, Gray-headed Junco. *H.*
Melospiza lincolni lincolni, Lincoln's Sparrow.
Tachycineta thalassina lepida, Northern Violet-green Swallow. *T.*
Wilsonia pusilla pileolata, Pileolated Warbler.
Cinclus mexicanus unicolor, Dipper or Water Ouzel. *T.*
Certhia familiaris montana, Rocky Mountain Creeper.
Sitta canadensis, Red-breasted Nuthatch.
Penthestes atricapillus septentrionalis, Long-tailed Chickadee. *T.*
Regulus satrapa satrapa, Golden-crowned Kinglet. *H.*
Regulus calendula calendula, Ruby-crowned Kinglet.
Myadestes townsendi, Townsend's Solitaire.
Hylocichla guttata auduboni, Audubon's Hermit Thrush.
Sialia currucoides, Mountain Bluebird. *T.*

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[1] Not positively known to breed. So little work has been done in this zone during the early breeding season that the list is very incomplete.

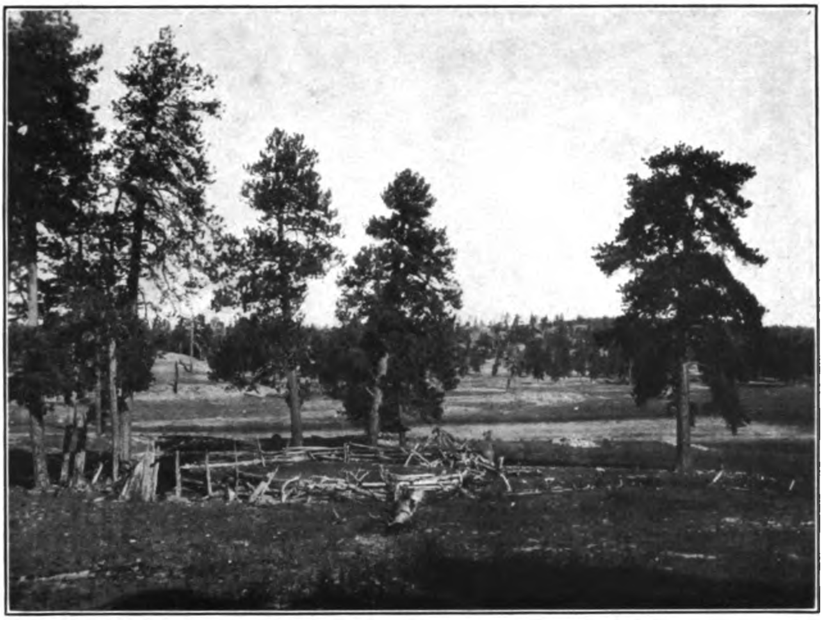

FIG. 1.—OPEN YELLOW PINE FOREST ON TOP OF THE CHUSCA MOUNTAINS.

Navajo sheep corral in foreground.

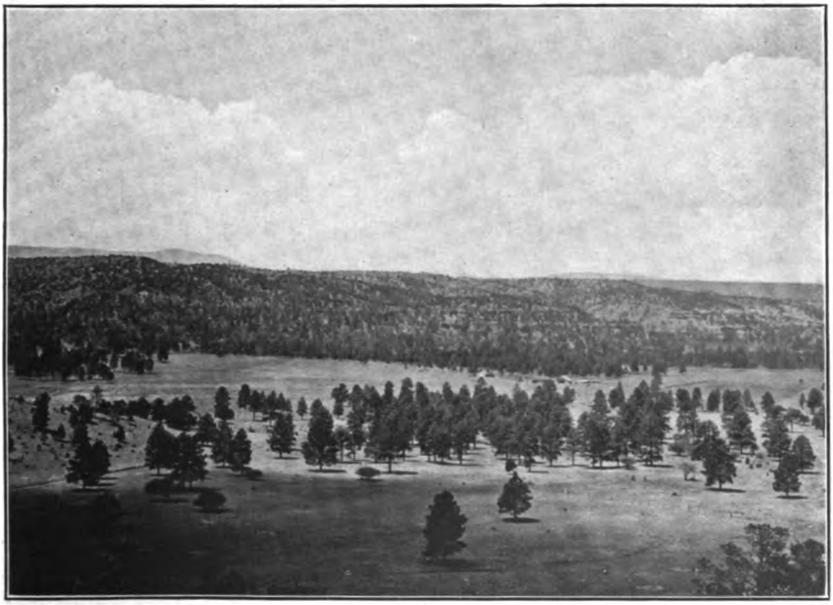

FIG. 2.—YELLOW PINE FOREST OF THE MOGOLLON MOUNTAIN PLATEAU.

The G O S ranch on the head of Sappello Creek.

PLATE VI.

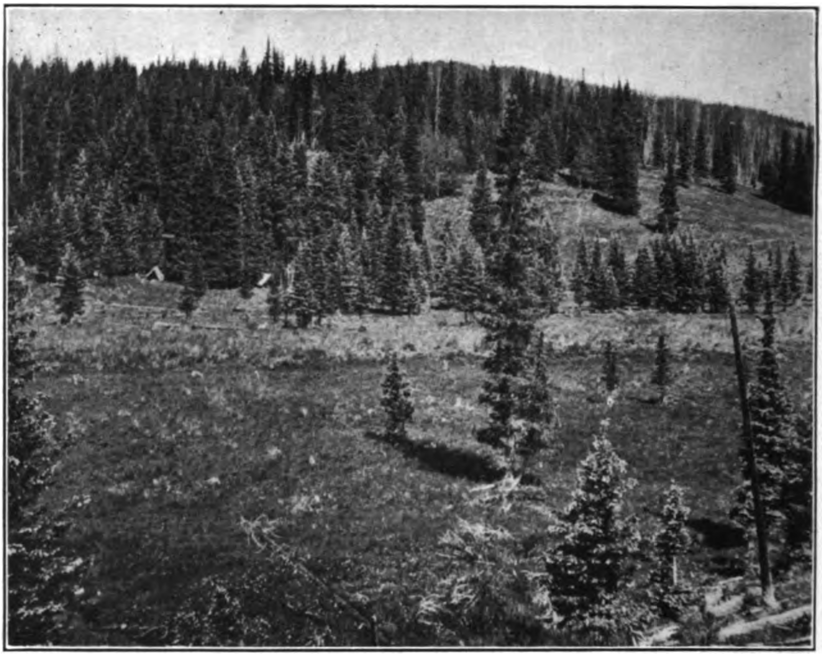

FIG. 1.—CANADIAN ZONE FOREST OF SPRUCE AND FIR AT 11,000 FEET ON JACK CREEK NEAR THE HEAD OF PECOS RIVER.

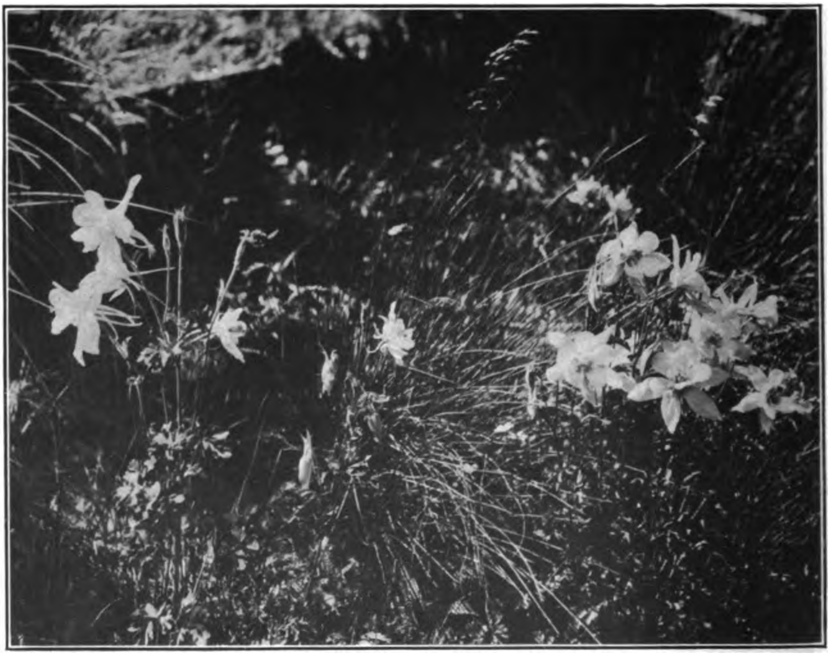

FIG. 2.—BLUE COLUMBINE, ONE OF THE ABUNDANT AND CONSPICUOUS FLOWERS OF THE CANADIAN ZONE PARKS, AT 11,000 FEET, PECOS MOUNTAINS.

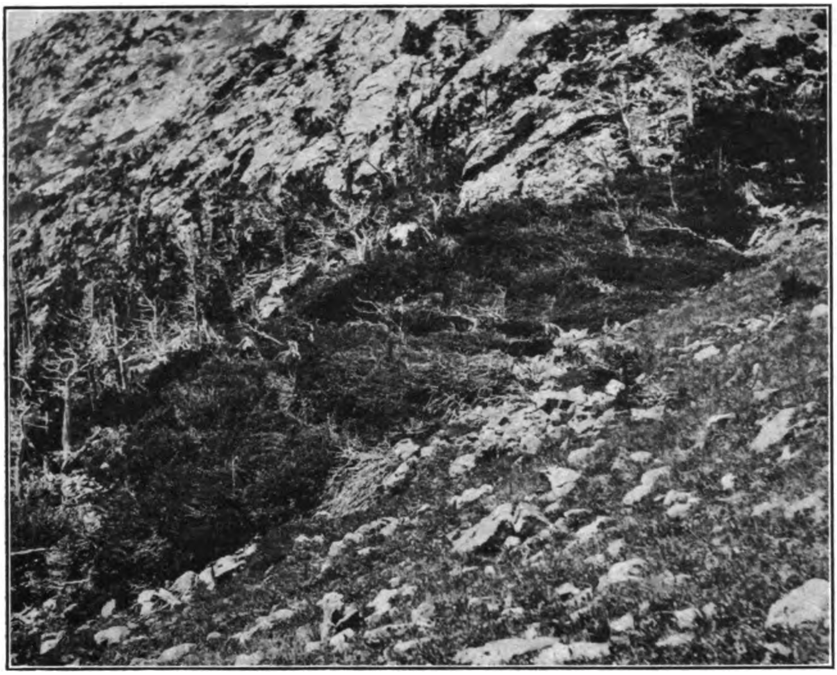

FIG. 1.—DWARF SPRUCE AND FIR AT 11,800 FEET ON EAST SIDE OF PECOS BALDY.

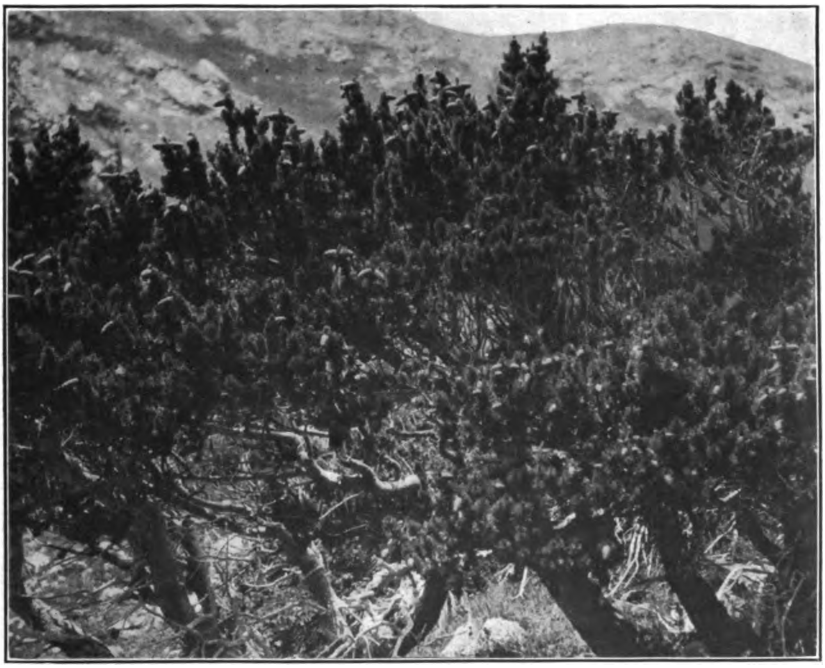

FIG. 2.—FOXTAIL PINES AT 11,800 FEET ON EAST SIDE OF PECOS BALDY. TYPICAL HUDSONIAN ZONE TREES.

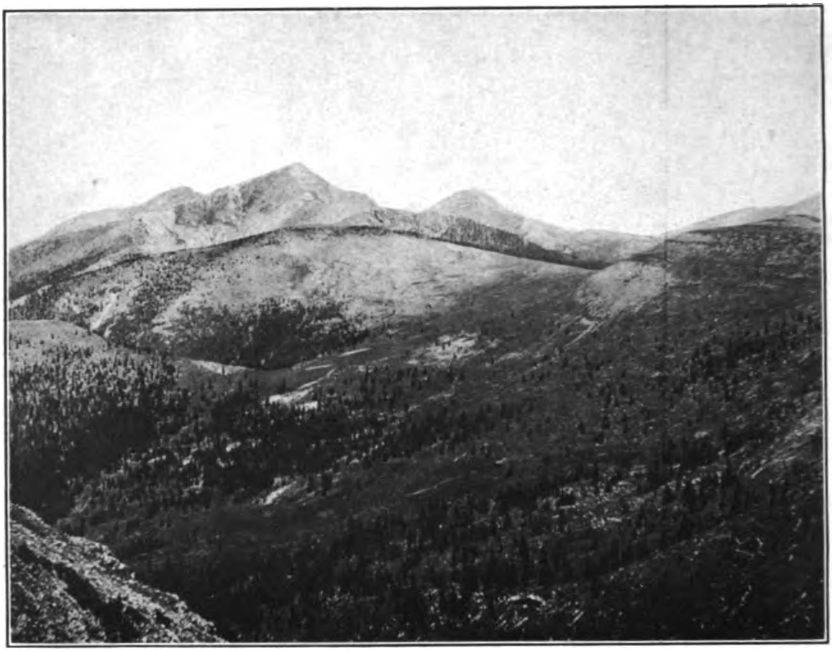

FIG. 1.—TRUCHAS PEAKS FROM THE SOUTH. HIGHEST PEAK, 13,300 FEET, TAKEN FROM 11,800 FEET ON THE SIDE OF PECOS BALDY.

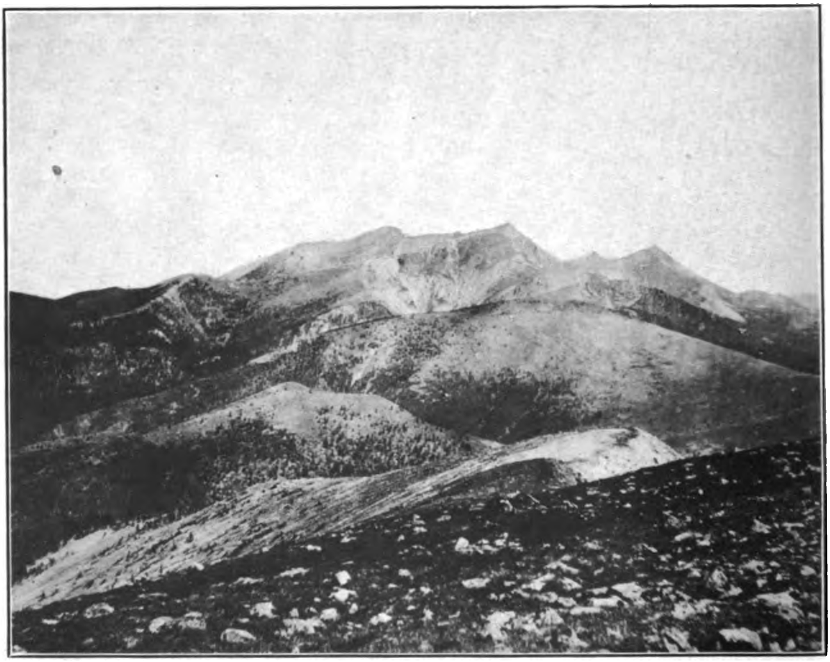

FIG. 2.—SANTA FE BALDY FROM THE NORTH. HIGHEST PEAK, ABOUT 12,600 FEET, TAKEN FROM TOP OF PECOS BALDY.

On both Truchas and Santa Fe Baldy the whole width of Hudsonian and Arctic-Alpine zones are shown, and appear much the same on the cold slope of the lower as on the warm slope of the higher peak.

PLANTS OF THE CANADIAN ZONE IN NEW MEXICO.

Species marked *T.* occur also in the Transition Zone; those marked *H.*, also in the Hudsonian; those marked *A.*, also in the Arctic-Alpine.]

Trees and shrubs.

Picea parryana, Blue Spruce.
Picea engelmanni, Engelmann Spruce.
Abies concolor, White Fir.
Pinus flexilis, Rocky Mountain White Pine.
Pseudotsuga mucronata, Douglas Spruce. *T.*
Juniperus sibirica, Shrubby Juniper.
Populus tremuloides, Aspen.
Acer glabrum, Rocky Mountain Maple.
Alnus tenuifolia, Alder.
Salix bebbiana, Bebb Willow. *T.*
Lepargyrea canadensis, Canadian Buffalo Berry.
Pachystima myrsinites.
Vaccinium erythrococcum, Red Blueberry. *H.*
Vaccinium oreophilum, Mountain Blueberry.
Ribes wolfi, Blue Currant.
Ribes coloradense, Black Currant.
Sorbus scopulina, Mountain Ash.
Sambucus microbotrys, Red Elderberry.
Lonicera involucrata, Black-fruited Honeysuckle.
Dasiphora fruticosa, Shrubby Cinquefoil.

Herbaceous plants.

Drymocallis convallarioides, Cinquefoil.
Veratrum tenuipetalum, Hellebore.
Aquilegia caerulea, Blue Columbine.
Delphinium cockerelli, Larkspur.
Aconitum porrectum, Monkshood.
Linnaea americana, Twinflower.
Pyrola secunda, Winter Lettuce.
Pyrola picta, Painted Pyrola.
Moneses uniflora, One-flowered Moneses.
Chimaphila umbellata, Pipsissewa.
Micranthes arguta, Saxifrage.
Parnassia fimbriata, Grass-o-Parnassus.
Parnassia parviflora, Small-flowered Grass-o-Parnassus.
Frasera stenosepala, Frasera.
Gentiana parryi, Mountain Closed Gentian.
Gentiana elegans, Mountain Fringed Gentian.
Mertensia (several species), Lungwort.
Polemonium confertum, Musky Jacob's Ladder. *H.*, *A.*
Polemonium foliosissimum, Pale Jacob's Ladder. *H.*
Pentstemon (several species).
Aragallus richardsoni, Richardson Milk Vetch.
Pedicularis racemosa, Purple Lousewort.
Elephantella groenlandica, Elephant-head.
Actaea viridiflora, Green-flowered Baneberry.
Viola nephrophylla, Blue Violet.
Viola neomexicana, Tall White Violet.
Dodecatheon radicatum, Shooting Star.
Sisymbrium vaseyi, Hedge Mustard.
Solidago parryi, Goldenrod.
Erigeron superbus, Large-flowered Erigeron.
Arnica cordifolia, Heart-leafed Arnica.
Carduus parryi, Yellow Thistle.
Carex bella, Sedge.
Carex aurea, Sedge.

Grasses.

Oryzopsis asperifolia, Mountain Rice.
Calamagrostis hyperborea americana, Reed Grass.
Deschampsia caespitosa, Hair Grass.
Deschampsia alpicola, Hair Grass. *H.*
Trisetum montanum, False Oats.
Avena striata, Oat Grass.
Danthonia spicata, Wild Oat Grass.
Danthonia intermedia, Wild Oat Grass.
Danthonia parryi, Wild Oat Grass.
Agrostis idahoensis, Redtop.
Festuca thurberi, Thurber Fescue.
Festuca arizonica, Arizona Fescue. *T.*
Festuca brachyphylla, Shortleaf Fescue. *H.*
Agropyron violaceum, Wheat Grass. *H.*
Agropyron bakeri, Wheat Grass. *H.*
Hordeum nodosum, Foxtail. *H.*

HUDSONIAN ZONE.

The Hudsonian Zone is found on the peaks that reach near or above timberline, mainly along the Sangre de Cristo Range, including the Pecos, Taos, Costilla, and Culebra Mountains, with traces on the White, Capitan, Sandia, and Jemez Mountains, Mount Taylor, and the Mogollons. Its total area in New Mexico probably does not exceed 300 square miles of steep mountain slopes. It is a narrow zone of about 1,000 feet in vertical extent, reaching normally from 11,000 to 12,000 feet on northeast slopes and 12,000 to 13,000 on southwest slopes, but often sending narrow tongues down steep gulches 1,000 feet below normal. It is generally well marked by a stunted growth of gnarled and dwarfed timber, mainly Engelmann spruce, cork-barked fir, and foxtail pine, but has many open slopes swept by wind and avalanche, where only depauperate vegetation, such as dwarf willows, gooseberries, geums, gentians, saxifrages, and clovers, mark the zone. The timber has little or no commercial value, a fact which is favorable to the continued usefulness of the zone as a conserver of water.

Buried under deep snows for 7 or 8 months of the year, the Hudsonian Zone contributes to agriculture mainly by storing water, which it holds until late in summer and yields during the driest part of the year. For a few months of late summer there is good grazing for sheep, the only animals adapted to these elevated slopes, but if overgrazed the steep slopes quickly become barren wastes of slide rock, and the grass cover has far greater value when left to protect the soil and conserve the water than when used to support a few sheep.

MAMMALS OF HUDSONIAN ZONE IN NEW MEXICO.

[Species marked *C.* occur also in the Canadian Zone.]

Ovis canadensis, Mountain sheep.
Marmota flaviventer, Rocky Mountain Woodchuck.
Ochotona saxatilis, Gray Rock Cony.
Ochotona nigrescens, Dusky Rock Cony.
Sorex obscurus, Dusky Shrew. *C.*
Sorex personatus, Masked Shrew. *C.*

BREEDING BIRDS OF HUDSONIAN ZONE IN NEW MEXICO.

[Species marked *C.* breed also in the Canadian Zone.]

Picoides americanus dorsalis, Alpine Three-toed Woodpecker. *C.*
Perisoreus canadensis capitalis, Rocky Mountain Jay. *C.*
Nucifraga columbiana,[1] Clark's Nutcracker.
Pinicola enucleator montana, Rocky Mountain Pine Grosbeak.
Zonotrichia leucophrys leucophrys, White-crowned Sparrow. *C.*
Junco phaeonotus caniceps, Gray-headed Junco. *C.*
Regulus satrapa satrapa, Golden-crowned Kinglet. *C.*

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[1] While this is one of the most characteristic summer birds of the Hudsonian Zone and is often seen in family parties, it breeds very early and probably in a lower zone. But few nests have been found and most of these in the Transition Zone.

PLANTS OF HUDSONIAN ZONE IN NEW MEXICO.

[Species marked *C.* occur also in the Canadian Zone; those marked *A.*, also in the Arctic-Alpine.]

Pinus aristata, Foxtail Pine.
Abies arizonica (dwarf), Cork-barked Fir. *C.*
Picea engelmanni (dwarf), Engelmann Spruce. *C.*
Salix saximontana, Creeping Willow. *A.*
Salix glaucops, Gray-leaved Willow.
Ribes lentum, Bristly Red Currant.
Clementsia rhodantha, Red Orpine. *A.*
Rhodiola integrifolia, Rosewort. *A.*
Rhodiola polygama, Rosewort. *A.*
Rhodiola neomexicana, Rosewort.
Polemonium delicatum, Slender Jacob's Ladder.
Phlox douglasi, Douglas Phlox. *A.*
Pentstemon gracilis, Purple Pentstemon.
Sieversia turbinata (*Geum rossi*), Mountain Avens. *A.*
Potentilla filipes, Cinquefoil. *A.*
Sibbaldia procumbens, Sibbaldia. *A.*
Caltha leptosepala, Elkslip (White Cowslip).
Trifolium parryi, Dwarf Clover. *A.*
Trifolium nanum, Dwarf Clover. *A.*
Trifolium stenolobum, Dwarf Clover. *A.*
Delphinium macrophyllum, Large-leaved Larkspur.
Delphinium alpestre, Alpine Larkspur. *A.*
Orthocarpus luteus, Yellow Orthocarpus.
Castilleja, Painted Cup.
Primula parryi, Parry Primrose.
Gentiana romanzovi, Dwarf Closed Gentian.
Swertia perennis.
Arenaria fendleri, Sandwort.
Polygonum bistortoides, Twisted Polygonum.
Carduus scopulorum, Yellow Thistle.
Dugaldea hoopesi, Yellow Dugald.
Dodecatheon radicatum, Shooting Star
Veronica wormskjoldi, Speedwell.
Heuchera parvifolia, Alum Root.
Senecio amplectens, Paintbrush.
Senecio triangularis, Paintbrush.
Senecio crassulus, Paintbrush.
Antennaria marginata, Everlasting.
Carex bella, Sedge.
Carex variabilis, Sedge.
Carex alpina,Sedge.
Juncoides parviflorum, Wood Rush. *A.*
Agropyron caninum, Wheat Grass. *C.*
Trisetum subspicatum, Oat Grass.
Phleum alpinum, Alpine Timothy.

ARCTIC-ALPINE ZONE.

Arctic-Alpine, the zone of the mountains corresponding to the Arctic barren grounds or tundra of the far north, caps the highest peaks along the Sangre de Cristo range, on the coldest slopes covering all above 12,000 feet, or on especially steep places all above 11,500 feet; on the warmest slopes covering all above 13,000 feet, or on very gradual slopes all above 12,500 feet. The total area of this zone in New Mexico probably does not amount to 100 square miles, most of which lies on cold slopes.

It is the treeless zone above the last dwarfed spruces, marked by low and often matted vegetation of hardy alpine plants, many of which occur on the Arctic tundra and reach their southernmost limits on these peaks. All are species adapted to a region where a frostless night rarely occurs during the short cold summer and where for 8 or 9 months they are buried under deep snows. On many of the cold slopes snow banks remain all summer, melting entirely only in exceptionally warm or dry years.

The zone owes its practical importance to its storage of moisture, which it lets down slowly during the summer when most needed in the arid valleys below. These cold mountain peaks seem to catch and hold the storms that gather and roar about them and cross from one to another in sweeping torrents of rain and hail while the valleys below lie dry and scorched. Thus by showers and melting snows the streams are fed and the best of the thirsty land below is watered.

The Arctic-Alpine Zone has in New Mexico no species of mammal not found in the zones below, and it has only three species of breeding birds. It contains, however, a considerable number of characteristic plants.

MAMMALS.

While the Arctic-Alpine Zone has in these mountains no species peculiar to it and no species that seem especially characteristic of it, unless the mountain sheep (*Ovis canadensis*) may be in part so considered, still several species penetrate into it to some extent, especially in summer. The long-tailed meadow mouse (*Microtus mordax*), a pocket gopher (*Thomomys fossor*), and the gray rock cony (*Ochotona saxatilis*) are sometimes taken in the Arctic-Alpine Zone, and may even winter under cover of its deep snow. The woodchuck (*Marmota flaviventer*), Colorado chipmunk (*Eutamias amoenus operarius*), red fox (*Vulpes fulva macroura*), and weasel (*Mustela arizonensis*) run over the peaks and ridges in summer, but apparently do not remain.

BREEDING BIRDS OF ARCTIC-ALPINE ZONE IN NEW MEXICO.

Lagopus leucurus leucurus, White-tailed Ptarmigan.
Anthus rubescens, Pipit, Titlark.
Leucosticte australis, Brown-capped Rosy Finch.

PLANTS OF ARCTIC-ALPINE ZONE IN NEW MEXICO.

[Species marked *H.* occur also in the Hudsonian Zone.]

Eritrichium argenteum, Alpine Forget-me-not.
Mertensia caelestina, Alpine Lungwort.
Claytonia megarrhiza, Arctic Spring Beauty.
Ranunculus macauleyi, Woolly Buttercup.
Paronychia pulvinata, Cushioned Whitlow-wort.
Papaver coloradense, Colorado Poppy.
Saxifraga cernua, Arctic Saxifrage.
Leptasea chrysantha, Yellow-flowered Saxifrage.
Leptasea flagellaris, Filamentose Saxifraga.
Micranthes rhomboidea, Wide-leaved Saxifrage.
Besseya alpina.
Sedum stenopetalum, Stonecrop.
Salix petrophila, Rock Willow. *H.*
Salix saximontana, Creeping Willow. *H.*
Salix chlorophila, Green Willow. *H.*
Oxyria digyna, Mountain Sorrel.
Gentiana romanzovi, Dwarf Closed Gentian.
Silene acaulis, Stemless Catchfly.
Alsinopsis obtusiloba, Sandwort.
Orthocarpus haydeni, Hayden Orthocarpus.
Pedicularis parryi, Short-beaked Lousewort.
Polemonium confertum, Jacob's Ladder. *H.*
Phacelia serisea, Silky Phacelia. *H.*
Androsace carinata.
Delphinium alpestre, Alpine Larkspur.
Aragallus parryi, Parry Loco.
Potentilla diversifolia, Cinquefoil.
Sieversia turbinata (*Geum rossi*), Mountain Avens.
Sibbaldia procumbens, Sibbaldia.

PLANTS OF ARCTIC-ALPINE ZONE IN NEW MEXICO—continued.

Polygonum viviparum.
Draba streptocarpa, Whitlow Cress.
Draba cana, Whitlow Cress.
Draba neomexicana, Whitlow Cress.
Ligusticella eastwoodae, Angelica.
Oreoxis bakeri, Cymopterus.
Thalictrum alpinum, Alpine Meadow Rue.
Artemisia scopulorum, Alpine Sagebrush.
Solidago ciliosa, Goldenrod.
Solidago decumbens, Goldenrod.
Erigeron melanocephalus, Fleabane.
Erigeron leiomeres, Fleabane.
Senecio holmi, Holm Paintbrush.
Tonestus pygmaeus.
Achillea subalpina, Alpine Yarrow.
Juncus drummondi, Rush.
Juncus triglumis, Rush.
Carex alpina, Sedge.
Carex ebenea, Sedge.
Carex nova, Sedge.
Carex siccata, Sedge.
Carex saxatilis, Sedge.

THE MOUNTAINS OF NEW MEXICO.

New Mexico is bountifully supplied with mountains, which are as essential to agriculture as valleys. In fact, without the valleys the mountains would still be of great value for timber, grass, and ores, while without the mountains the valleys would be of little value because they would be almost waterless. For half the year the higher mountains are practically uninhabitable on account of cold weather and deep snow, but for the other half, when they are pouring streams of pure water into the lowlands, they are serving also as the summer resort and pleasure ground for the valley dwellers, not only from New Mexico, but from other States. There is therefore an imperative need for the careful guarding of these valuable assets of a developing state: Water, forests, grass, and a great outdoor playground for its people. An intimate knowledge of the more important ranges is the first step toward adequate protection of their natural resources.

SANGRE DE CRISTO MOUNTAINS.

Two branches of the main Rocky Mountain mass of Colorado extend into northern New Mexico, the San Juan Range on the west and the Sangre de Cristo Range[1] on the east of the Rio Grande Valley. The Sangre de Cristo is the highest and most extensive range in the State, with broad plateaus, high mountain valleys, and three groups of peaks (Culebra, Taos, and Truchas) rising above 13,000 feet. From Colorado it extends south between and a little beyond Santa Fe and Las Vegas in a broad and well-defined range. The lowest saddle in this range is Taos Pass, 9,280 feet; the highest point is Wheeler Peak, 13,600 feet. There is usually a central crest of sharp peaks and ridges rising above the broad shoulders of the elevated plateau. In places the range is double, with high interior valleys, and throughout it has a complex series of long, steep, and often rocky exterior ridges reaching down to the outer plains. The upper slopes, lying mainly above 10,000 feet, are deeply cut or broadly rounded by comparatively recent glacial action. Numerous cirques or glacial amphitheaters cutting into the base of the higher ridges and peaks give ample evidence of the forces that chiseled the cliffs and gouged the hollows. Numerous and often extensive lateral or terminal moraines stretch across or along the edges of the valleys. An example of the usual type of stream source in these well-watered mountains is the head of Pecos River. A mile below the little lake, at 11,700 feet, from which the river rises, the stream rushes down a morainal dam, apparently 500 or 600 feet high, to flow for some distance through a round-bottomed valley, after which it cuts its way out of the mountains through a sharp-bottomed gulch. Numerous other lakes, some mere shallow ponds of snow water, others deep green basins left behind the moraines or scooped out of the solid rock in glacial paths, form the headwaters of visible or hidden streams. These are mainly near or above 11,000 feet, but lower down the stream courses are almost devoid of natural reservoirs. Springs and creeks are numerous from near timber line down through the Hudsonian and Canadian Zones, but become scarcer toward the base of the mountains as the streams gather into larger and more widely separated channels.

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[1] The United States Geographic Board has ruled that the name Sangre de Cristo shall apply to this range north to Poncha Pass, Colorado. The names Culebra, Costilla, Taos, Cimarron, and Pecos Mountains are applied locally to sections of the range and should be used only in a restricted sense.

Until the midsummer rains begin the mountain slopes are drenched with melting snow. As late as August 14, 1903, a few large snow banks still occupied the cold slopes of the Truchas Peaks, while one small drift yet remained behind the crest of Pecos Baldy. On August 12, 1904, a little of the old snow still clung to the cold slopes on Taos and Wheeler Peaks, and on August 20 some large banks were found on Culebra Peak. It is doubtful if the winter's snow ever entirely leaves these tall crests of the range, which during most of the short summer are heavily streaked with white.

During July and August showers, often violent, are of frequent occurrence about the peaks. In consequence of this abundant moisture over the upper slopes, vegetation has a vigorous growth, even where reduced to a carpet of Alpine plants. The coniferous forests of the upper slopes where undisturbed by fire are dense and clean. Grass is abundant in the open, and the parks and timberline meadows are brilliant flower gardens. Even the highest peaks, when not of bare rock, are carpeted with dwarf Arctic and Alpine plants of exquisite beauty and fragrance.

The forests lie in well-marked belts, or zones, around these mountains, as is plainly seen where a broad view of the range can be had from an elevated point on some opposite range, and as is approximately shown in colors on the zone map. The upper timber zone, or Hudsonian, is but a vanishing fringe of forest, where the foxtail pine and stunted spruce and fir struggle for bare existence among the rocks.

The zone of spruce and fir, or Canadian Zone, covers most of the high central part of the mountains from about 9,500 feet to 12,000 feet on southwest slopes and from 8,500 feet to 11,000 feet on northeast slopes. It extends down in broad strips on the outer slopes, even reaching in narrow tongues in canyons as low as 7,500 feet or clear through the Transition Zone. At one place at 7,500 feet where the Pecos flows through a deep narrow gulch, spruces and firs cover the cold slope, while just over the crest of the ridge on the warm slope 10 rods distant there are nut pines, junipers, and live oaks. Such overlapping or interlacing of zones merely shows the extreme effect of local configuration on temperature. Both upper and lower edges of the zone are regular only in a broad sense, as they vary in altitude with slope exposure, steepness of the slopes, and to a less extent with air currents, moisture, and soil cover. When unmarred by fire this forest is usually characterized by dense areas of slender pointed spruces (*Picea pungens* and *engelmanni*) and firs (*Abies concolor* and *arizonica*), but much of the timber has been burnt and replaced by equally dense areas of white-stemmed aspens. Most of the timber is small, but here and there large old spruces stand out alone or tower above their neighbors. In the deep shade of the timbered areas a few characteristic wood plants dot the brown carpet of needles, but there is rarely much undergrowth until fire has swept away or thinned out the timber. Repeated burning has cleared extensive areas which now lie as open meadows or grassy parks.

The zone of yellow pine, or Transition Zone, covers the lower slopes of the mountains from approximately 7,500 to 9,700 feet on southwest slopes and 7,000 to 8,500 feet on northeast slopes. Its upper limit is variable on account of the varying steepness of the slopes, rising even to 10,000 feet on steep rocky southwest slopes, or falling to 7,500 feet in steep northeast gulches.[1] The yellow pine forest, as shown in blue on the zone map, encircles the Sangre de Cristo Mountains, and extends over the big mesa south of the Santa Fe Railroad and along the cold slope down the river below San Miguel, then over other mesa tops to the east as far as Mesa Yegua and north to Sierra Grande and the Raton Mesa. Usually the yellow pines stand in scattering growth or open forest, occasionally in dense groves of young trees. The Douglas spruce also is an important tree in the upper part of this zone, which it invades from the Canadian Zone above, while several of the deciduous oaks are irregularly distributed through it, and the narrow-leaved cottonwood borders most of the streams.

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[1] These extremes, due to local details of topography and slope, have, to avoid confusion, been commonly ignored in discussions of life zones; and in certain cases this fact has been used by persons unfamiliar with the effects of slope exposure and local air currents in criticism of well-established laws of distribution.

The zone of juniper and nut pine, or Upper Sonoran Zone, covers the foothills and reaches out over the surrounding plains and valleys. Along the Pecos River Valley it ascends on southwest slopes to about 7,500 feet and along the west base of the range to about the same altitude. On northeast slopes in the Pecos Valley and along the east base of the range it reaches to about 7,000 feet. The upper edge of the zone is marked by the limit of nut pine, juniper, several species of cactuses and yuccas, and many shrubby plants, and the beginning of tall yellow pine timber.

Animal life in these mountains is abundant and in many ways is of unusual interest. Such rare birds as rosy finches, pine and evening grosbeaks, pipits, solitaires, three-toed woodpeckers, and ptarmigan are found during summer high up in the mountains, while Clark's nutcrackers, Rocky Mountain jays, and long-crested jays are regular camp visitors. Water ouzels bob in the streams, thrushes, kinglets, warblers, vireos, tanagers, juncos, and sparrows sing exuberantly during their breeding season, and brilliant hummingbirds flash among the flowers. There are also a few band-tailed pigeons and some dusky grouse and wild turkeys.

White-tailed and mule deer are present, although becoming scarce, coyotes and black bears are fairly common, and there are still a few grizzlies or silvertips, gray wolves, and red foxes. The beavers are increasing under recent protection. The big tuft-eared gray squirrels are an interesting feature of the yellow pine belt, while the little spruce squirrels and striped chipmunks give added life and interest to the forest. Big woodchucks whistle from the ledges and bowlders and the odd little rock conies squeak and stack their hay under slide rock near timberline. Pocket gophers, mice, and shrews burrow into the mountain slopes or make tiny roads under cover of protecting vegetation.

Most of the streams are well stocked with trout, which often penetrate to the very sources of the little creeks above 10,000 feet. With proper restrictions good fishing and hunting can be permanently maintained and even greatly improved.

The mountains form a natural park and ideal pleasure ground for summer camping and attract more campers each year. Some day they may be more highly valued for this purpose than for sheep range and lumber yield.

From the majority of campers here, as elsewhere, much remains to be desired in camp ethics, especially in guarding the forests from fire and their inhabitants from wanton destruction, in beautifying rather than desecrating camp grounds, in guarding streams from pollution, and so sharing health and happiness with others and passing these advantages on to future generations. The useless destruction of song birds and harmless animals is due mainly to ignorance. To any but a human brute the beauty and songs and interesting ways of

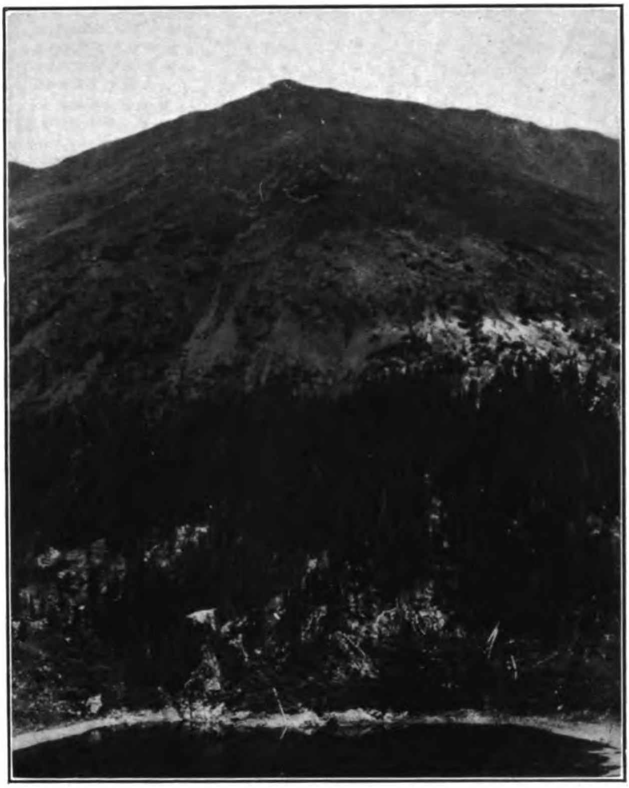

FIG. 1.—WHEELER PEAK, 13,600 FEET, THE HIGHEST POINT IN NEW MEXICO. TAKEN FROM THE WEST BASE AT 11,200 FEET, SHOWING FULL RANGE OF HUDSONIAN AND ARCTIC ALPINE ZONES. TIMBER LINE IS ABOUT 12,000 FEET.

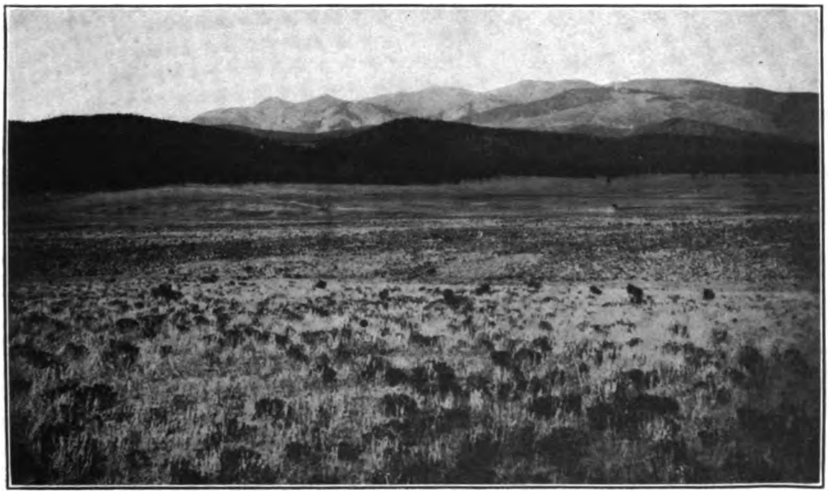

FIG. 2.—SANGRE DE CRISTO MOUNTAINS, TAKEN FROM THE EAST ACROSS MORENO VALLEY AT 8,000 FEET.

The highest peaks are not shown. The timber bordering valley is yellow pine.

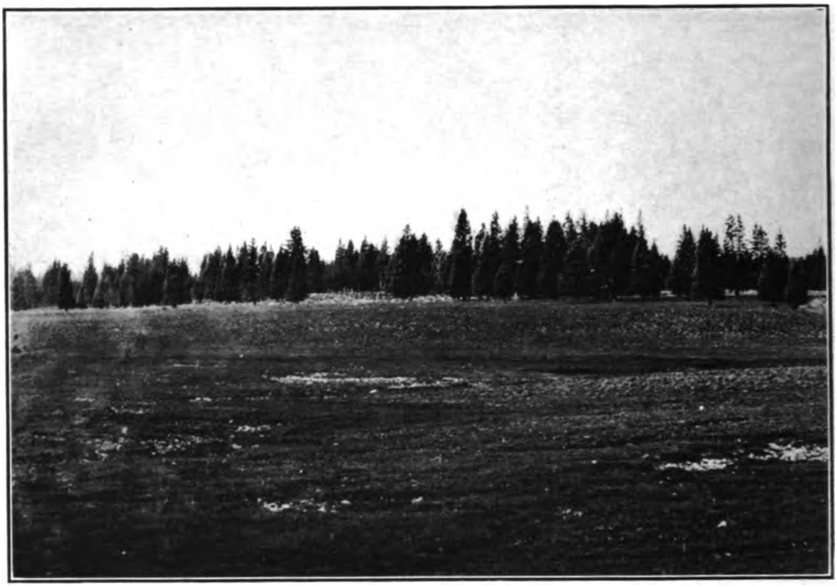

FIG. 1.—MEADOW PARK AT 10,000 FEET ON TOP OF THE SAN JUAN MOUNTAINS.
The timber is spruce and fir.

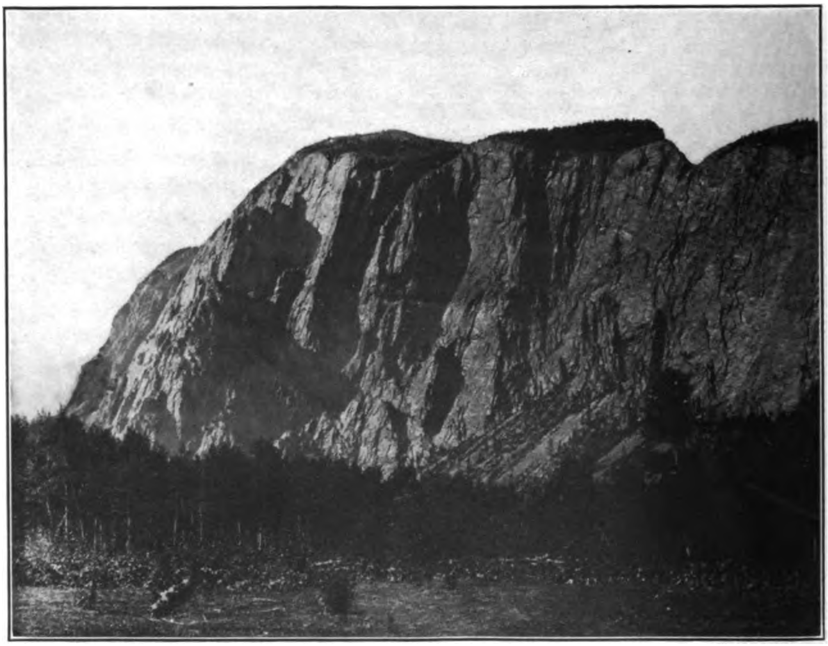

FIG. 2.—EL CHORO, A 3,000-FOOT GRANITE WALL OF BRAZOS CANYON, ON WEST SLOPE OF SAN JUAN MOUNTAINS.

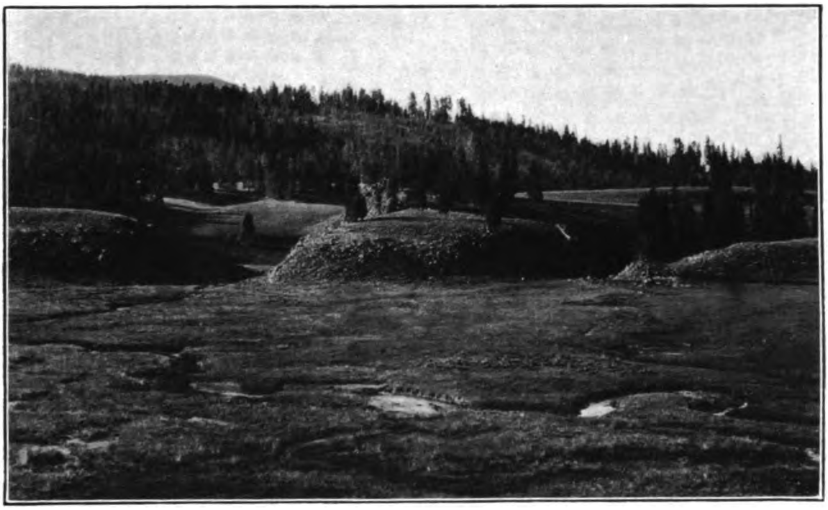

FIG. 1.—VALLE SANTA ROSA AT 8,500 FEET IN JEMEZ MOUNTAINS.

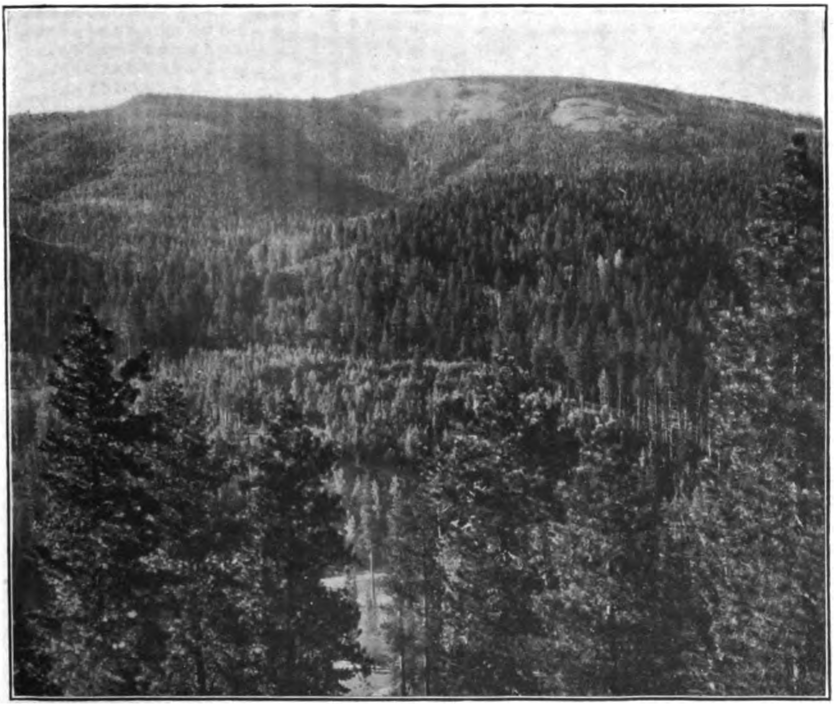

FIG. 2.—NORTH SLOPE OF GOAT MOUNTAIN (10,400 FEET) FROM HEAD OF SANTA CLARA CREEK AT 8,500 FEET.

Yellow pines in foreground; distant timber mainly spruce and fir.

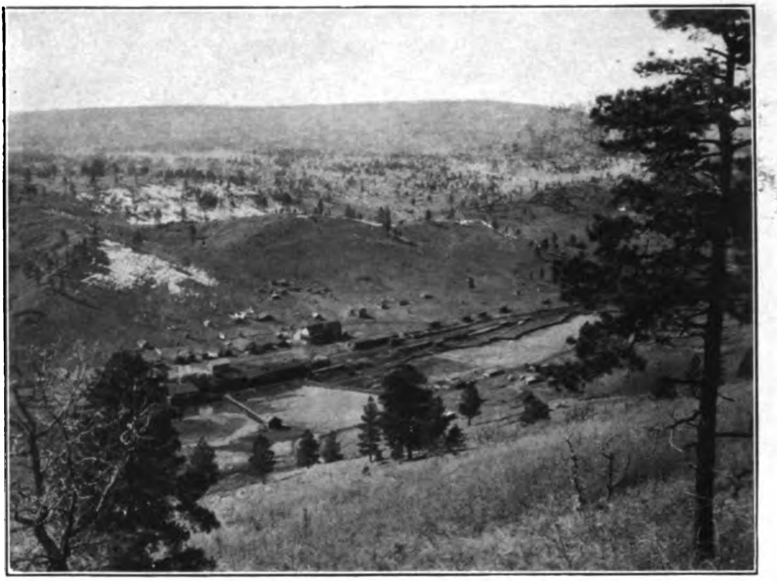

FIG. 1.—RAILWAY STATION OF KETTNER AT EDGE OF YELLOW PINE FOREST IN ZUNI MOUNTAINS.

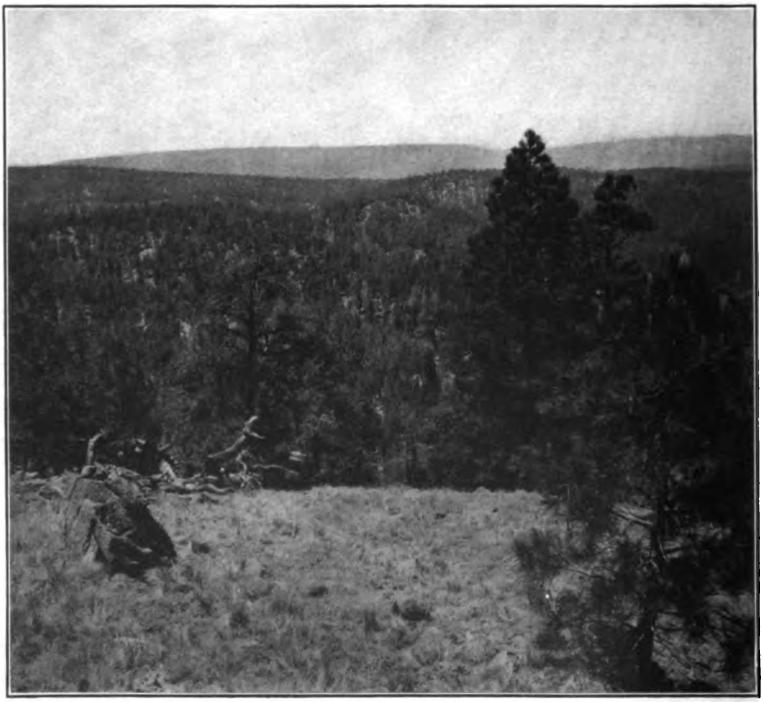

FIG. 2.—YELLOW PINE FOREST IN ZUNI MOUNTAINS LOOKING NORTH FROM MOUNT SEDGWICK.

Photograph by E. A. Goldman.

our wood neighbors in feather or fur appeal more strongly than do their dead and mangled bodies. From the boy or man who once begins to study them more closely than at rifle or shotgun range they are comparatively safe.

SAN JUAN MOUNTAINS.

West of the Rio Grande Valley the San Juan Mountains extend from Colorado south to the Chama River, which separates them from the Jemez Mountains and interrupts what would be otherwise a continuous range. The San Juans are a wide and not very high range, with a broad expanse of plateau top at about 10,000 feet and few points rising to 11,000 feet. Their broad middle slopes are largely covered with open yellow-pine forests and the upper slopes with dense growth of spruce and fir, alternating with great grassy parks and meadows. On the west slope deep canyons cut into the range, and along at least one of these, the Brazos Canyon, east of Tierra Amarillo, rise sheer granite cliffs, Yosemite-like in size and structure. The lack of timberline peaks gives a tameness to these mountains that is increased by gentle slopes and good roads over the highest parts of the range, but among the advantages are ease of access to many beautiful camp grounds, good springs, abundant grass, cool forests, and sunny slopes, while many rough canyons offer picturesque grounds for exploration.

These mountains differ from the Sangre de Cristo range in animal and plant life, mainly in the absence of Hudsonian and Arctic forms of higher altitudes. Both ranges are characterized by the Rocky Mountain species of southern Colorado, with comparatively few subspecific variations.

JEMEZ MOUNTAINS.

The Jemez Mountains are of about the same extent and general character as the San Juans, from which they are separated by the deep narrow canyon of the Chama River. They are largely volcanic, with the highest peaks standing as remnants of old crater rims 10,000 to 11,500 feet high. Santa Clara is the highest peak, while several others are only a little lower.[1] Pelado Peak is 11,266 feet high, Abiquiu 11,240, and Goat Peak, just south of the head of Santa Clara Creek, 10,400.

None of these reaches true timberline, although on northeast slopes near their summits the timber is dwarfed and a few Hudsonian Zone plants are found.

On the middle slopes of the mountain, streams and springs are numerous, but the high peaks and ridges are generally without water. Some of the streams disappear or are used for irrigation before they extend far into the valleys, while others carry their surplus water to the Rio Grande. Numerous dry washes show evidence of fierce floods that tear down them during heavy rains. The mountains are generally well covered with soil and vegetation except where cliffs and canyon walls break through and long lines of broken lava extend down from the peaks. A number of large park-like valleys at 8,000 to 9,000 feet afford valuable grazing land, but most of the mountain area is well forested.

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[1] Santa Clara is the peak just north of the headwaters of Santa Clara Creek and south of Abiquiu Peak. The name seems to have been omitted from recent maps, but it is correctly located and named on the maps of the Wheeler Survey of 1874.

Spruces, firs, and aspens fill most of the Canadian Zone, yellow pines and Gambel's oaks mark the Transition Zone, and nut pines, junipers, and live oaks cover the Upper Sonoran foothills.

The plant and animal life is mainly that of the southern Colorado mountains, and rock conies (*Ochotona*) and snowshoe rabbits reach here almost as far south as in the Pecos Mountains. Elk and Mountain sheep have disappeared, but mule deer are still found in fair numbers. There are a few black bears, but grizzlies are now very scarce if any remain. There are a few mountain lions and many bobcats, coyotes, gray foxes, badgers, porcupines, prairie dogs, squirrels, and chipmunks. Wild turkeys are now scarce, but dusky grouse are common high up in the mountains. The jays, magpies, woodpeckers, and song birds are much the same as in the Sangre de Cristo Mountains. There is good trout fishing in many of the streams and delightful camp grounds are easy of access. Still some of the most delightful are accessible only by pack outfit through forests or over rough trails.

Stock raising is the principal industry. In summer great numbers of cattle and sheep range over the upper valleys and slopes and in winter return to the valleys. Few people live in the mountains, as they are mainly too high for agriculture, but the warm Upper Sonoran canyons at their bases have long been occupied by Pueblo Indians living on the grounds of their cliff-dwelling ancestors, or by settlers on the numerous land grants.

The agricultural land of the region is restricted to narrow valley bottoms that can be irrigated. Small ranches along these valleys usually show primitive methods and poor crops, but the soil is very productive and in a few places under better management good crops of wheat, corn, potatoes, chili, beans, and alfalfa are raised and such fruits as apples, pears, peaches, nectarines, and grapes do well.

MOUNT TAYLOR RANGE.

Southwest of the Jemez Mountains lies the Mount Taylor Range or group,[1] in close connection with the Zuni Mountains; then come the

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[1] There has been much confusion in regard to the name of this group of mountains, parts of which have been called San Mateo, Sierra Chivato, and Cebolleta Mountains. The name San Mateo is also applied to the range west of San Marcial; the other names apply to local ridges or mesas. As Mount Taylor is the highest point, its name has been used to designate the group.

Datil and Pinon Mountains leading across the high plains to the Mogollons, the last great link in the broken chain between the Rocky Mountains and the Sierra Madre of Mexico.

The Mount Taylor group is a broad volcanic plateau with the great ruin of an old lava crater, Mount Taylor proper, at its southern end, standing 11,389 feet at the highest point of its wide semicircular rim and inclosing a steep little secondary cone about 1,000 feet high. Part of the plateau is lava from this old crater, part from numerous smaller craters scattered over its surface. Series of great sandstone ridges stretch away to the west beyond Fort Wingate, including Hosta Butte, Navajo Church, Mesa Butte, and Sierra de Los Lobos, which almost connect with the Zuni and Chusca Mountains. These ridges, 7,000 and 8,000 feet high, are mainly flat-topped mesas like the Chusca and the western part of the Zuni Mountains. The mountains are not well watered. A beautiful permanent creek winds down inside the old crater of Mount Taylor and cuts its way out through the broken rim on the south. A few other little creeks and scattered springs breaking out around the edges of the mountains are permanent, but the greater number of streams are merely spring torrents from melting snow.

The greater part of both outer and inner slopes of the old crater is densely forested with spruce, fir, and aspen, and much of the lower part is open grass land.

The Canadian Zone area is so restricted and isolated that it seems to lack many of the mammals and birds of the more extensive areas to the north and south, although more species will doubtless be found when it is thoroughly worked. Mule deer, black bears, porcupines, a meadow mouse which may be *M. mordax*, and a little shrew seen but not collected, were found in this zone. Long-crested jays, red crossbills, evening grosbeaks, western goshawks, white-crowned and Lincoln's sparrows, and juncos were common here in September, and crossbills, thrushes, and pileolated warblers were found by Hollister in August, but these were not necessarily all on their breeding grounds. Wild turkeys breed here, but I could find no trace of blue grouse.

The mesa tops and lava plateau and most of the outer slopes of Mount Taylor itself are covered with a scattered forest of yellow pine and patches of Gambel's oak. The Transition Zone area is more extensive and less isolated than the Canadian and is characterized by many of the Rocky Mountain species of mammals and birds. The tuft-eared gray squirrels, chipmunks, Colorado wood rats (*Neotoma mexicana fallax*), pocket gophers, Rocky Mountain cottontails, raccoons, and such birds as band-tailed pigeons, pygmy and Rocky Mountain nuthatches, Audubon's and Grace's warblers, hairy and ant-eating woodpeckers, western robins, and chestnut-backed bluebirds are common.

The Upper Sonoran foothills of these mountains are generally covered with junipers, nut pines, and live oaks, and inhabited by rock squirrels (*Citellus variegatus grammurus*), rock chipmunks (*Eutamias dorsalis*), white-throated wood rats (*Neotoma albigula*), pocket mice, kangaroo rats, Texas jack rabbits, Woodhouse's jays, bush tits, and the usual set of species of this part of the zone, which spreads over the valleys without restriction.

Agriculture in the more fertile Upper Sonoran gulches around the edges of these mountains is mainly of a primitive type and carried on by Indians and Mexicans.

CHUSCA MOUNTAINS.

The Chusca Mountains[1] are a long low range, in reality a long mesa or plateau, extending from a little north of Gallup northward across the New Mexico and Arizona line and almost connecting with the Carrizo Mountains, a higher, rougher group lying mainly in Arizona. Most of this mesa is of sandstone, 8,000 to 9,000 feet high, with abrupt rimrock margins, but toward the north there are ridges of rough lava rock and basaltic cliffs. The top is an undulating forested country with great numbers of shallow lakes, usually without outlets. Below the rim are numerous springs and short creeks that rise in the canyons and flow for a short distance down the steep slopes or in a few cases out into the neighboring valleys. There is abundance of water for stock, but very little for irrigation.

The cold upper slopes, especially of the rims and canyons, are covered with aspens and a few firs and spruces (*Abies arizonica*, *Picea pungens*, and *Pseudotsuga taxifolia*). Rocky Mountain maple, Canadian buffalo berry (*Lepargyrea canadensis*), and shrubby juniper (*Juniperus communis*), are common, but nowhere is an extensive area of Canadian Zone. The spruce squirrel (*Sciurus fremonti mogollonensis*), Colorado chipmunk (*Eutamias amoenus operarius*), mountain meadow mouse (*Microtus mordax*), pocket gopher (*Thomomys fossor*), and little shrew (*Sorex vagrans monticola*) are common Canadian Zone species. The birds, as noted in October, include a few that probably breed there in the Canadian Zone—the long-crested jay, Clark's nutcracker, junco, and white-crowned sparrow—but most of the species observed then were migrants.

The main part of the top and upper slopes of this plateau range lies in the Transition Zone and is covered with a beautiful clean open forest of yellow pines with generally a carpet of grass or low shrubs beneath. Gambel's oak covers many of the steep slopes and the Douglas spruce grows in some of the gulches. Bearberry (*Arctosta-*

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[1] The name Chusca, or Choiskai, is generally applied to the southern half, and Tunicha, or Tunitcha, to the northern half of this perfectly continuous and nearly uniform range. There is certainly not room for two names, and I have used the one that seems better known and in its shorter form, which is in common use among local residents.

phylos uva-ursi) and wild tea (*Ceanothus fendleri*) often carpet the ground. A little cactus (*Mamillaria vivipara*) and a depauperate narrow-leafed yucca (*Yucca baileyi*) grow on open arid slopes in this zone. Some of its most characteristic mammals are the tuft-eared Abert squirrel, prairie dog, Colorado woodrat (*Neotoma fallax*), Apache pocket gopher, and Rocky Mountain cottontail. A few of the resident birds found in the Transition Zone in October and that undoubtedly breed there are the wild turkey, ant-eating woodpecker, and the pygmy and Rocky Mountain nuthatches.

The Navajo Indians live in large numbers in the open canyons or wide gulches around the base and lower slopes of these mountains. Here on moist, mellow flats their garden patches yield a good supply of corn and wheat, beans and squashes for winter provisions; their herds of sheep, goats, cattle, and horses range out on the plains or up the mountain sides; scattered nut pines, junipers, and live oaks furnish not only fuel and shelter but even food; and the yellow pines come down low enough to be available for house logs and timbers. It is a region of primitive comforts but with no possibility of a great future in agriculture.

In summer many of the Indians with their herds migrate to the cool broad top of the range, where there is good grazing and abundance of water. Numerous "hogans," summer huts of rude pattern, are scattered over the top, but there are no evidences of attempted agriculture except the sheep corrals and occasional little horse pastures. During my trip over the Chuscas in October, 1908, the mountains were practically deserted except for stray bands of cattle and ponies, and wisely so on account of cold nights, driving wind, and rain and snow.

The Navajo Indians in their religious reverence for feathered spirits have made their great reservation to some extent a bird preserve. Ducks are unmolested in the lakes and doubtless breed there in considerable numbers. Wild turkeys have held their own unusually well, but have suffered somewhat from hunting by outsiders and Christianized Indians. Some mammals, considered sacred, especially the black bear and coyote, have also thrived, while the mule deer and antelope have been exterminated over a wide area. Prairie dogs are now popular game animals and the Indians, who shoot and dig them out for food, have almost depopulated some of the dog towns.

ZUNI MOUNTAINS.

At their highest eastern end, where Mount Sedgwick rises to an altitude of about 9,300 feet, the Zuni Mountains are rough and volcanic, but to the west they are great flat-topped ridges 8,000 to 9,000 feet high, largely of sandstone with abrupt rimrock edges. Extensive lava fields with numerous small craters stretch off to the south and east, while isolated buttes and ridges are scattered beyond.

The mountains are well timbered but poorly watered. The few small streams that flow down the mountain valleys reach the plains only during high water. The timber is mainly yellow pine in open forest, now largely cut over but originally of great extent and value. There are some Douglas spruces and Gambel oaks; aspens and spruces cover the higher cold slopes and we found there in June a number of Canadian Zone birds, such as the western goshawk, long-crested jay, Clark's nutcracker, junco, Williamson's and red-naped sapsuckers, broad-tailed hummingbird, western flycatcher, pine siskin, ruby-crowned kinglet, Audubon's warbler, brown creeper, and Audubon's hermit thrush.

Although considerable collecting has been done in these mountains, the only purely Canadian Zone mammal yet found is the silver-haired bat (*Lasionycteris noctivagans*), taken in June at 8,600 feet, but probably there are others.

Transition Zone birds and mammals are common and include both northern and southern forms. The painted redstart and Mearns's quail reach their northern limits here, though they are of rare occurrence. Wild turkeys are becoming scarce. The hairy woodpecker, western wood pewee, spurred and green-tailed towhees, black-headed grosbeak, western tanager, Grace's warbler, pygmy and Rocky Mountain nuthatches, western robin, and chestnut-backed bluebird are found in the breeding season. The little Sonora white-tailed deer reaches its northern limit in the Zuni Mountains, according to reports of hunters, but it is very scarce there now. The Abert squirrel, Rocky Mountain chipmunk (*Eutamias quadrivittatus*), Colorado wood rat (*Neotoma fallax*), Mogollon field mouse (*Microtus mogollonensis*), fulvous pocket gopher (*Thomomys fulvus*), Arizona porcupine (*Erethizon epixanthum couesi*), and Rocky Mountain cottontail (*Sylvilagus nuttalli pinetis*) are characteristic of the Transition Zone.

A few ranches are situated in the Transition Zone valleys, where good crops of potatoes and oats are raised on the rich mountain soil, but most of the agriculture of the region is carried on in the Upper Sonoran valleys around the base of the mountains.

MOGOLLON MOUNTAINS.

The necessity for a group name for the mountains of western Socorro County, New Mexico, is apparent to all who know or speak of them. While the maps give names to the many local ranges comprising this group, people constantly speak of these ranges collectively by the name of the highest central peaks, the "Mogollons." In the broadest sense this term is made to include the Mogollon, Burro, Black, Mimbres, Diablo, Little, Elk, Tularosa, Tucson, Datil, Pinyon, Oak Spring, and San Francisco Ranges, which form one extensive and irregular mountain mass, a continuation of the chain which includes the White Mountains of Arizona. The name has now become restricted to that part of this chain lying in middle western New Mexico. To the northwestward they are loosely connected through the White and San Francisco Mountains of Arizona with the ranges extending through central Utah, and still more loosely through the Zuni Mountains with the Rocky Mountains of northern New Mexico and Colorado. But in both these cases the connection is much closer than with the Sierra Madre of Mexico to the south, where a broad belt of low plains intervenes.

The greater part of the Mogollon Mountain mass is a rough plateau 7,000 to 8,000 feet high, deeply cut with many canyons and here and there ridged with 9,000- and 10,000-foot ranges. At least three of the central peaks of the Mogollons reach an altitude of about 11,000 feet, but not high enough for any true timberline or for many Hudsonian Zone species. Still they are high enough to be of great importance, for on the border of a region of low hot deserts they receive a heavy fall of rain and snow. They feed most of the sources of the Gila River, several forks of which rise close under the highest peaks, and they have been called the Gila Mountains. They are covered by the Datil National Forest on the north and the Gila National Forest on the south, formerly mainly included under the name Gila National Forest.

The mountains are largely volcanic, and many of the high ridges and plateau tops are of very old, deeply cut, and eroded lava rock. There are many other formations, however, including numerous ore-bearing strata. Many of the cliffs and canyon walls along the branches of the Gila and San Francisco Rivers are sandstone, much eroded and full of cracks and caves.

The Canadian Zone covers most of the higher peaks and ridges above 8,500 feet on cold slopes and 9,500 feet on warm slopes. Except for the burned-over areas it is a zone of dense forest of spruce, firs, and aspens, with a few dwarf maples and many undershrubs, such as *Juniperus communis*, *Sorbus scopulina*, *Pachystima myrsinites*, *Vaccinium oreophilum*, *Ribes wolfi*, *Grossularia pinetorum*, *Rubacer parviflorus*, *Distegia involucrata*, and other purely Rocky Mountain species.

The following birds found in these mountains in early spring and late summer probably breed in the Canadian Zone, although little work has been done there during the actual breeding season: dusky grouse, alpine three-toed woodpecker, broad-tailed hummingbird, western wood pewee, long-crested jay, Clark's nutcracker, pine siskin, Cassin's purple finch, white-crowned sparrow, junco, Audubon's warbler, ruby-crowned kinglet, dipper or water ouzel, and Audubon's hermit thrush.

The Canadian Zone mammals are Merriam elk (now extinct), Arizona spruce squirrel, Rocky Mountain meadow mouse, red-backed mouse, and mountain shrew.

The area covered by this zone is generally steep and difficult of access, of little value for timber, and of less use for stock or agriculture. Its worth as a source of water supply for rich valleys below can hardly be realized. As a permanent breeding ground for game birds and mammals, as a source of beautiful and teeming trout streams, and as an ideal camping resort to which people flock from the hot valleys below, its importance is steadily increasing.

The Transition Zone spreads in wide areas over the plateau tops and the middle slopes of the ranges from approximately 6,500 to 8,500 feet on cold slopes and 8,000 to 9,500 feet on warm slopes. It is characterized by beautiful open forests of yellow pines, with scattered Douglas spruce and a sprinkling of Mexican white pine. In places there are scrubby oaks of the *gambeli* group, the white-leaved oak, and New Mexico locust, and along the streams are generally fringes of narrow-leaved cottonwood, alders, willows, and cornel. Among the low and scattered undershrubs are *Ceanothus fendleri*, *Berberis repens*, *Arctostaphylos uva-ursi*, *Symphoricarpos oreophilus*, *Sericotheca dumosa*, and the nonshrubby vegetation includes *Wyethia arizonica*, *Frasera speciosa*, *Gilia pulchella*, and *Pentstemon torreyi*.

A few of the Transition Zone birds are Merriam's turkey, band-tailed pigeon, Lewis's woodpecker, Cabanis's woodpecker, ant-eating woodpecker, Stephens's whippoorwill, western wood pewee, evening and black-headed grosbeaks, western vesper sparrow, spurred towhee, western tanager, western martin, red-faced warbler, painted redstart, and pygmy and Rocky Mountain nuthatches.

The mammals of this zone are the handsome Abert squirrel, gray-collared chipmunk, Arizona ground squirrel, San Francisco Mountain wood rat, rusty white-footed mouse, Mogollon meadow mouse, Arizona porcupine, fulvous pocket gopher, Rocky Mountain cottontail, and brown bat.

This open clean-trunked forest is not only of great and permanent value as a source of lumber supply to a vast treeless region, but it affords much of the finest grazing land in the State. There is far more humidity than in the valleys, and if the range is not overstocked the grazing need not interfere with forest growth and reproduction.

Some agriculture on very restricted areas would be possible in this zone, but its value would be little in comparison with that of the present forest, water, and grazing. Over a great part of the area the surface presents the formation commonly termed "malpais," which consists of extensive lava beds partly covered with thin layers of soil and with angular fragments of lava strewing the ground so thickly as to make traveling difficult, and in most places to render cultivation impossible.

The Upper Sonoran valleys of the Mogollon Mountain region are the part of greatest agricultural importance, but these have been treated under the subdivisions of that zone, mainly under the Gila Valley.

MAGDALENA AND SAN MATEO MOUNTAINS.

The Magdalena and San Mateo Mountains are so closely connected with the Mogollon Mountains and resemble them so much in general features and fauna and flora that they might well be included in the group if narrow Upper Sonoran valleys did not intervene. The following description is from reports by E. A. Goldman, who has worked in both ranges.

They extend along the west side of the Rio Grande Valley in Socorro County as steep, rugged desert ranges, reaching approximately 10,000 feet in altitude. They are very rocky, with numerous side canyons and sharp ridges and steep slide rock slopes. They retain but little of the water that falls on them, and while showing deep erosion they have few streams and only occasional springs. The little available water along their basal slopes is, however, of great value, as the surrounding country is devoted mainly to stock raising. They are scantily forested with the usual Rocky Mountain trees.

Three life zones are represented: Canadian, Transition, and Upper Sonoran. The Canadian Zone covers a narrow crest along each range and extends down to 9,500 feet altitude on hot slopes and to 8,500 feet on cold slopes. It is characterized by such trees as the aspen, white fir, Douglas spruce, and Rocky Mountain maple; by the long-crested jays, Clark's nutcracker, junco, and Townsend's solitaire; and by the Rocky Mountain meadow mouse, a red-backed mouse, and a little shrew.

Transition Zone covers the lower slopes of the mountains from about 7,000 to 8,500 feet on cold slopes and from 8,000 to 9,500 feet on hot slopes. It is characteristized by scattered yellow pines, narrow-leaved cottonwoods, oaks of the *Quercus gambeli* group, *Ceanothus fendleri*, *Sericotheca*, *Prunus*, gooseberries, and currants. Its birds and mammals are practically the same as those of the Transition Zone of the Mogollon Mountains.

The Upper Sonoran foothills and basal slopes are characterized by the usual juniper, nut pine, live oak, bear grass, yucca, and cactus. There are numerous dry washes and a few springs and streams. Agriculture is limited mainly by lack of water to a few garden patches and a little fruit raised for home use in the canyons and gulches. There is usually good grazing over the foothills and basal plains, and stock raising is an important industry.

SAN LUIS AND ANIMAS MOUNTAINS.

The San Luis and Animas Mountains form in the southwestern corner of New Mexico the northern terminus of the Sierra Madre of Mexico. The higher part of the San Luis range lies south of the boundary line, but the Animas range north of San Luis Pass is practically a continuation of it, and attains an altitude of 8,600 feet near its northern end. The Big Hatchet Mountains (8,300 feet) and Peloncillo Mountains (about 6,500 feet) are outlying ranges less closely connected with the main Sierra Madre but largely occupied by the same set of species. Hemmed in on the north, east, and west by hot Lower Sonoran valleys, these steep, rough, arid little ranges are widely separated from the Mogollons and Rocky Mountains on the north. As the Animas peaks are the highest and most northern part of this ragged terminus of a great range, their plant and animal life is of particular interest.

Their altitude is sufficient to give them a trace of Canadian Zone, represented in cold gulches near the summits by patches and streaks of aspens, a few long-crested jays and red-backed juncos, western flycatchers, and hoary bats.[1] But little collecting has been done in these high gulches, and more work will probably increase the list of Canadian species.

The Transition Zone area in the Animas Mountains is more extensive than the Canadian and better known, reaching on northeast slopes from 7,000 feet to the top (8,600), and on southwest slopes from 8,000 feet to the top, and to the south almost connecting with that of the San Luis Mountains. It contains a number of small streams and although mainly on steep, rather dry slopes it is far from barren. Besides the scattered forest of large trees it is partly occupied by a tangle of undergrowth. The timber, which is most abundant on the colder and moister slopes, is composed of Douglas spruce, yellow, white, Arizona, and Chihuahua pines, several oaks, including *Quercus hypoleuca*, *reticulata*, *wilcoxi*, and *gambeli*, Arizona madrone, and willow-leaved cherry. Part of the oaks are shrubby, and with them are also buckthorn (*Rhamnus smithi*), *Sericotheca dumosa*, *Rubus neomexicanus*, *Ceanothus fendleri*, brake (*Pteridium aquilinum pubescens*), wild potato (*Solanum tuberosum*), and many other characteristic Transition Zone plants.

Few of the mammals are restricted to the Transition Zone in so limited an area, but the wood rat (*Neotoma mexicana*), fulvous pocket gopher (*Thomomys fulvus*), cottontail (*Sylvilagus f. holzneri*), black and grizzly bears, and mountain lion are common residents.

Transition Zone birds are represented by Merriam's turkey, the band-tailed pigeon, Cabanis's woodpecker, Stephens's whippoorwill, broad-tailed and Rivoli's hummingbirds, spurred towhee, black-headed grosbeak, western tanager, Stephens's vireo, Virginia, black-throated gray, and red-faced warblers, painted redstart, pygmy and Rocky Mountain nuthatches, Mexican chickadee, and western robin. These were found between July 26 and August 9, and all may have been bred in these mountains.

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[1] Two hoary bats shot in the Animas Valley on Aug. 10 probably came down out of the mountains for water, although they may have been migrating.

The Upper Sonoran Zone covers the base of these mountains and reaches up on the warm slopes to the tops of all but a few of the highest peaks. On open foothill slopes it is marked by scattered live oaks (*Quercus arizonica* and *emoryi*), junipers (*Juniperus monosperma* and *pachyphloea*), a tree yucca (*Yucca schotti*), two species of century plant (*Agave palmeri* and *schotti*), bear grass (*Nolina lindheimeriana*), sotol (*Dasylirion wheeleri*), and an arborescent cactus (probably *Opuntia versicolor*), and along dry washes by gum elastic (*Bumelia rigida*), sycamore (*Platanus wrighti*), and black walnut (*Juglans major*), while above on the steeper slopes its vegetation thickens up to a dense chaparral with the addition of several shrubby oaks, manzanita (*Arctostaphylos pungens*), mountain mahogany (*Cercocarpus paucidentatus*), silk tassel (*Garrya wrighti*), skunk bush, (*Schmaltzia trilobata*), and *Fendlera rupicola*. A few of the five-leaved Mexican nut pines (*Pinus cembroides*), scattered through this chaparral, yield good nuts which with the acorns, walnuts, juniper berries, and many other seeds and fruits provide abundant food for birds and beasts. Animal life is abundant and well protected by the dense vegetation.

The common Upper Sonoran mammals of the mountains and foothills are the little Sonora white-tailed deer (*Odocoileus couesi*), rock squirrel (*Citellus variegatus grammurus*), rock chipmunk (*Eutamias dorsalis*), white-throated wood rat (*Neotoma albigula*) Rowley white-footed mouse (*Peromyscus boylei rowleyi*), gray fox (*Urocyon cinereoargenteus scotti*), civet cat (*Bassariscus astutus flavus*), and spotted skunk (*Spilogale ambigua*).

The mountain birds of this zone are Mearns's quail, the Arizona and ant-eating woodpeckers, poor-will, black-chinned hummingbird, Arizona jay, canyon towhee, hepatic tanager, Baird's wren, and bridled titmouse.

While the San Luis and Animas Mountains are of relatively slight importance for lumber, grazing, or agriculture, they still catch moisture and render the surrounding valleys habitable and valuable. There are no rivers of any importance for irrigation, but the streams that sink at the base or half way up the sides of the mountains break out lower down in springs, or carry a supply of good water below the surface to the bottoms of broad valleys. Thus stock raising becomes the most important industry, and where open water can not be found within reach of good grazing areas, wells or tanks are used. Eventually parts of these warm rich-soiled valleys will be reclaimed by pumping from wells or reservoirs supplied by water from the mountain slopes.

Incidentally the mountains are of some value as natural game preserves, but in such small areas the game will soon be exterminated unless protected. At present the country is so thinly settled that protection for game depends mainly on the interest of the ranch owners and the more intelligent settlers. In most cases, however, local interests are powerless against outside hunting parties and irresponsible campers.

BIG HATCHET MOUNTAINS.

The following description is by E. A. Goldman, who was in the range in July, 1908:

The Big Hatchet Mountains in the southeastern part of Grant County form a steep, rugged, desert range with a trend from northwest to southeast. They are steep and rough on all sides, but are tilted upward very abruptly toward the west. The highest peak, near the northern end of the range, is over 8,000 feet high. Toward the southern end the range divides and nearly surrounds a small, open valley, while farther south rises another rugged but lower desert range or group called the Alamo Hueco or Dog Mountains. On the northeast of the Big Hatchet Mountains the low range called Doyle Hills crosses the international boundary into Chihuahua, and farther to the eastward in Chihuahua is the Sierra Boca Grande, similar in height, trend, and general character to the Big Hatchet Mountains. All the mountains of the general region are very arid, and no permanent water or even temporary "tanks" were found in the Big Hatchet Mountains. The broad, gently sloping

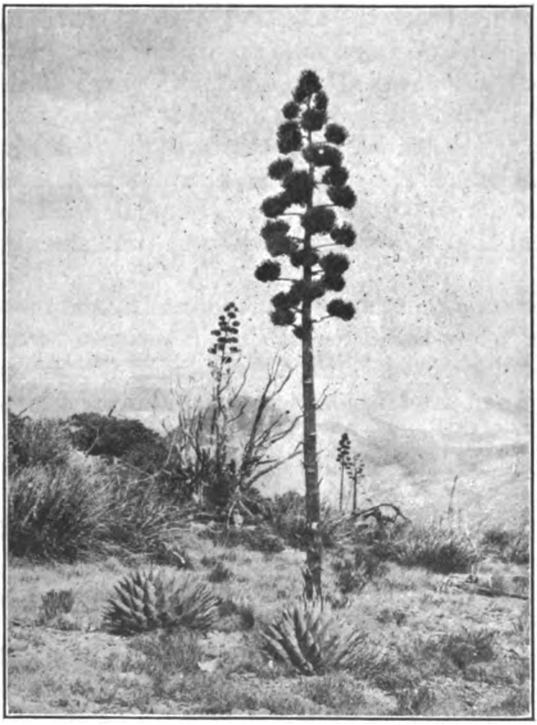

FIG. 4.—Parry century plant in full flower at 8,100 feet on top of the Big Hatchet Mountains. Photograph by E. A. Goldman.

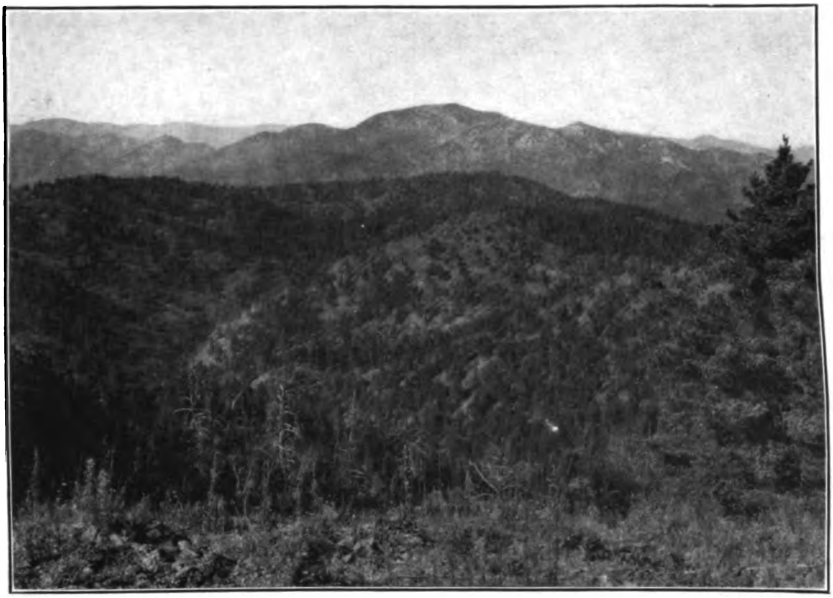

FIG. 1.—MIMBRES MOUNTAINS FROM TOP OF SAWYERS PEAK (10,000 FEET), LOOKING NORTH.

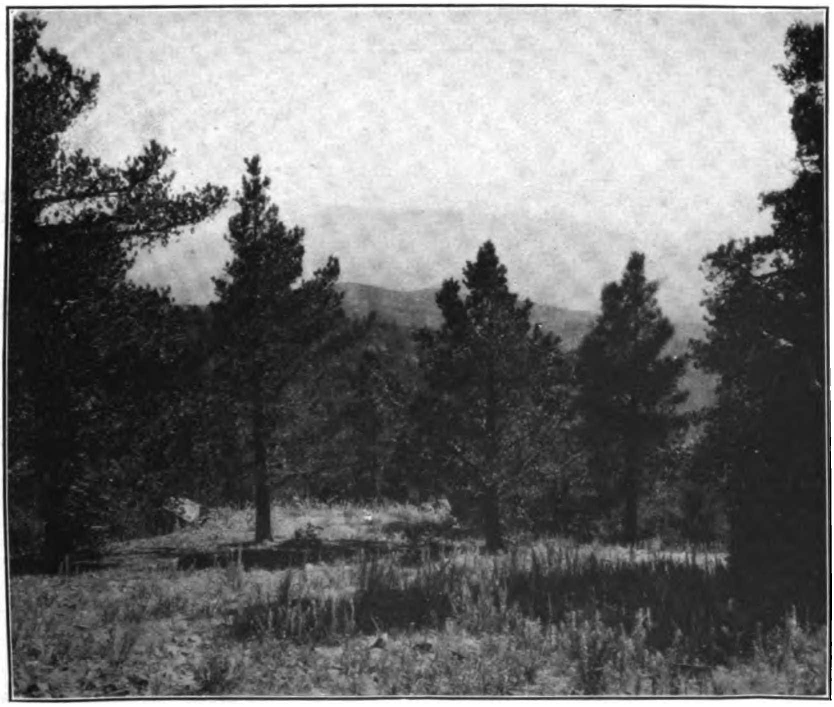

FIG. 2.—MIMBRES MOUNTAINS FROM TOP OF SAWYERS PEAK, LOOKING SOUTH.

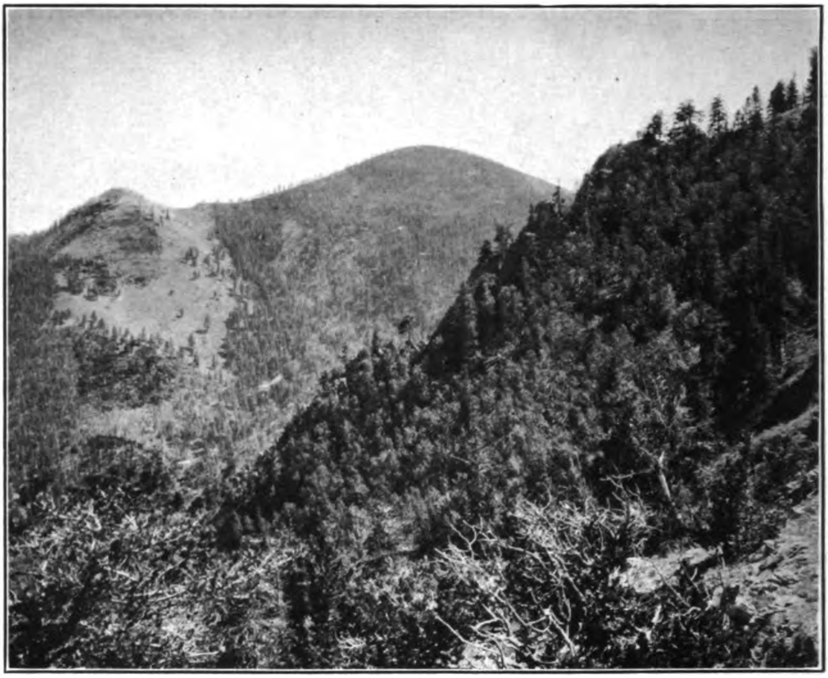

FIG. 1.—UPPER TIMBERED SLOPE OF MAGDALENA MOUNTAINS.
Photograph by E. A. Goldman.

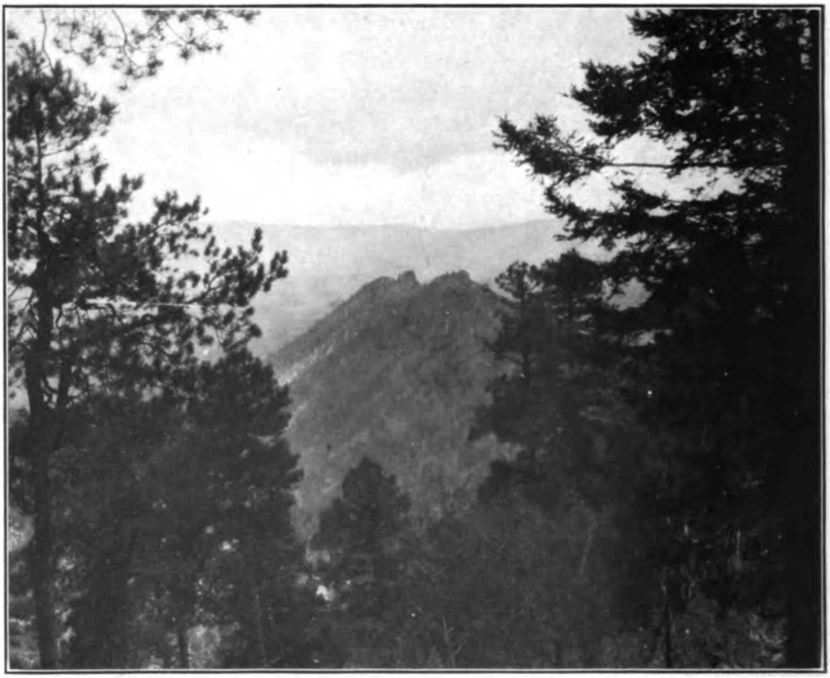

FIG. 2.—UPPER TIMBERED SLOPES OF SAN MATEO MOUNTAINS.
Photograph by E. A. Goldman.

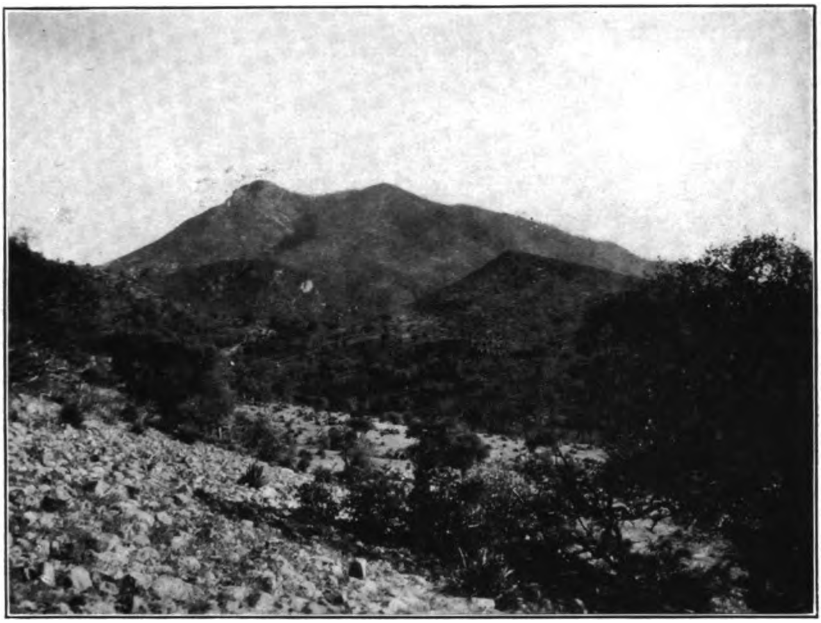

FIG. 1.—ANIMAS PEAK (8,600 FEET) FROM NORTHWEST BASE.

Live oaks, cactuses, yuccas, and bear grass in foreground.

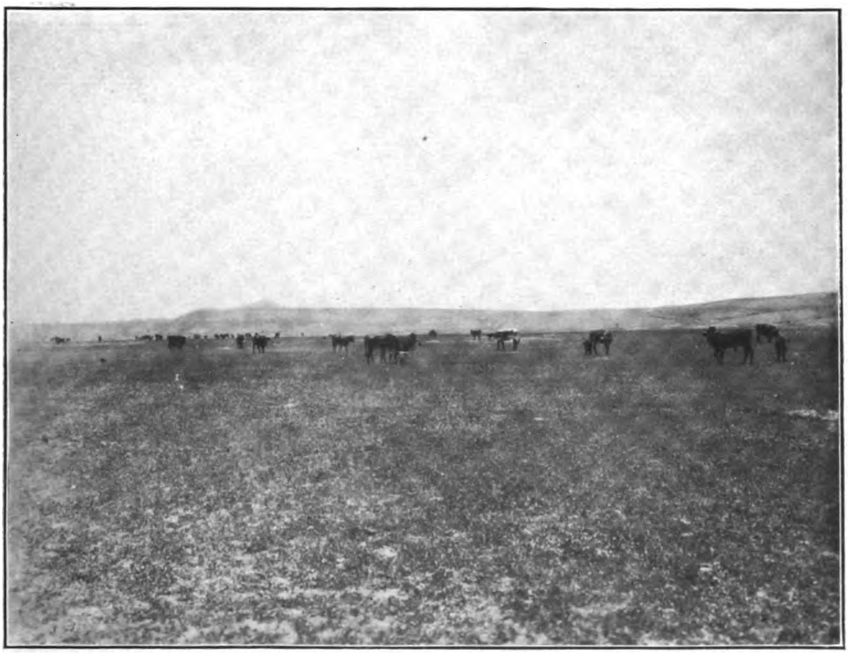

FIG. 2.—UPPER SONORAN BORDER OF THE ANIMAS VALLEY.

An excellent stock range.

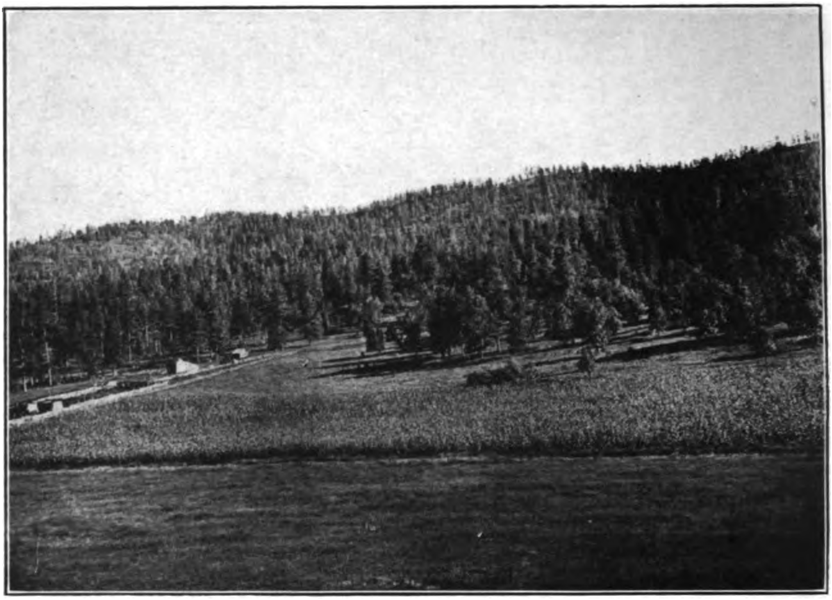

FIG. 1.—FIELD OF OATS AMONG THE YELLOW PINES ON THE EAST SLOPE OF THE SACRAMENTO MOUNTAINS AT 7,800 FEET.

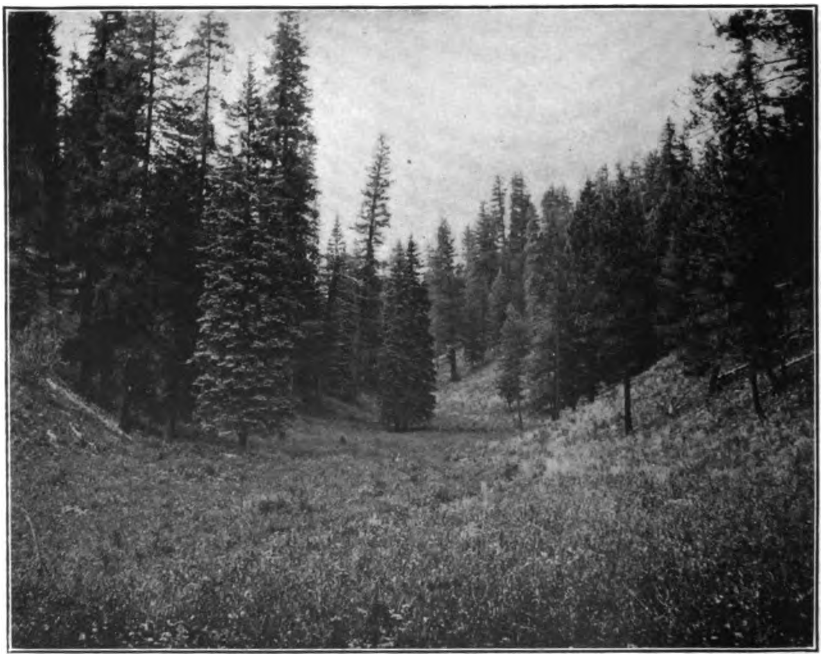

FIG. 2.—FOREST AT 9,000 FEET IN THE SACRAMENTO MOUNTAINS.

Blue spruce and white fir on the cold slopes, yellow pine on warm slopes, and parks full of flowers between.

Hachita Valley extends along the eastern side of the mountains, at about 4,200 feet altitude, with drainage toward Lake Guzman, Chihuahua, while the Great Playas Valley lies west of the mountains.

The Big Hatchet Mountains lie mainly within the Upper Sonoran Zone, which gives way to the Lower Sonoran along the east slope of the foothills at about 4,700 feet altitude. The north slope above about 7,000 feet should be Transition Zone in climate, although the mountains are very barren and no characteristic species of the zone were recorded. The common Upper Sonoran vegetation consists of Mexican nut pine, checker-barked and silky junipers, several oaks, fringe ash (*Fraxinus cuspidata*), shrubby trefoil (*Ptelea*), two species of silk-tassel bush (*Garrya wrighti* and *goldmani*), *Fendlera rupicola, Ceanothus greggi*, southern mountain mahogany (*Cercocarpus paucidentatus*), *Sericotheca, Fallugia*, cat's claw (*Mimosa biuncifera*), *Cassia wislizeni*, *Nolina*, and on top the beautiful Parry century plant.

MANZANO AND SANDIA MOUNTAINS.

The Manzano and Sandia Mountains form the eastern border of the Rio Grande Valley opposite Albuquerque and Belen. The northern part of the range is known as the Sandias and the southern part as the Manzanos, the two ranges being separated by a high pass or open saddle. The Manzanos are joined loosely toward the south to the lower San Andres Mountains by way of the Cerro Montoso, Chupadero Mesa, and Sierra Oscuro, but the main part of the range includes only the Manzano and Sandia Mountains, which reach altitudes of about 10,000 and 11,000 feet, respectively, and carry narrow crests of the Canadian Zone and a wider and continuous area of the Transition Zone. On the west these ranges drop abruptly to the low Rio Grande Valley, while eastward they slope off gradually to the high open plains. The upper zones are narrow on the steep, barren west slope and much wider on the gradual and better-forested eastern side. Though in the midst of an arid country, these mountains are high enough to induce considerable precipitation, which results in a good cover of vegetation and extensive forests. There are numerous springs and a good supply of underground water far down the slopes, but streams are few and mainly ephemeral.

The Canadian Zone covers the tops of these mountains and the cold slopes down to about 8,000 feet. It is well marked by a rather meager forest of white fir, blue spruce, Douglas spruce, *Pinus flexilis*, aspen, and Rocky Mountain maple, with mountain ash, alders, and willows in cold gulches and along streams. It has a few characteristic mammals, the spruce squirrel, pocket gopher, dusky shrew, and probably others not yet recorded. The breeding birds are little known, as most of the field work done in the range has been late in the season. On July 30 I found half-grown wild turkeys near the top of the Manzano range, but they may have wandered up from below after the nesting season. I also found olive-sided flycatchers, juncos, and thrushes that were probably on their breeding grounds.

The Transition Zone covers the greater part of the mountains from approximately 7,000 to 8,000 feet on cold slopes and 8,000 to 9,000 feet on warm slopes. On the east side of the range it spreads out over a wide area of gently sloping ridges and mellow-soiled valleys, well clothed with open yellow pine forest, scattered oaks of the *Quercus gambeli* group, New Mexico locust, and low undergrowth of *Ceanothus fendleri*, *Berberis repens*, *Sericotheca*, *Opulaster*, and many other Rocky Mountain plants. Some of the common birds in July were flickers, ant-eating and hairy woodpeckers, western wood pewee, black-headed grosbeak, spurred towhee, western chipping sparrow, and pygmy and Rocky Mountain nuthatches, while a flock of young turkeys seen up in the Canadian Zone were probably hatched in the Transition. Of the mammals collected in this zone the chipmunk, Guadalupe meadow mouse, Manzano cottontail, and brown bat are among the most characteristic. There are still some mule deer and black bears in the mountains. There is good grazing throughout the zone, which seems of greater value for timber, stock, game, and summer camping grounds than for its very limited possibilities of agriculture.

The Upper Sonoran Zone of the foothills and surrounding valleys is the main zone of agriculture and stock raising. The foothill division of this zone is of particular interest along the eastern slope of the mountains, where it carries picturesque little forests of nut pine, juniper, and scrub oaks, with tree cactus, prickly pear, yuccas, red barberry, skunk brush (*Schmaltzia trilobata*), and other shrubs scattered between. Many little farms and stock ranches are located along this slope in sheltered corners where some irrigation is obtained from flood water and where dry farming yields occasional crops. The old apple trees at Manzano, from which the mountains are named, are said to be over 100 years old. They are very large but yield poor ungrafted fruit. Much if not most of this juniper belt would seem admirably adapted to apples if sufficient moisture for the growth of trees and fruit could by proper cultivation be conserved in the soil. The natural growth of grama and other grasses is good and forms fine grazing, while the gulches and timber afford good shelter for stock.

SACRAMENTO MOUNTAINS.

The name Sacramento Mountains is applied by the United States Geographic Board to the range lying west of Pecos Valley, New Mexico, and includes the groups locally known as the Jicarilla, Sierra Blanca, Sacramento, and Guadalupe Mountains. These form a practically continuous chain of ranges about 140 miles in length and 30 miles in greatest width. They lie between the Pecos and Alamogordo valleys and extend a little below the Texas line. On the west and north they are distantly linked by high mesas with the Manzano Range and these again by other high mesas with the Sangre de Cristo Mountains, which are part of the Rocky Mountains proper.

Sierra Blanca, the highest peak in the range, rises 11,880 feet. The Capitans are over 10,000 feet, the Sacramentos, near Cloudcroft, 9,500 feet, and the Guadalupes, near the Texas line, 9,000 feet. The lowest pass is over the Guadalupe arm, which comes down to about 7,000 feet. On the west and at the north and south ends the mountains are abrupt and rugged, while on the east in the broad central part they slope gradually down to the broad plains of the Pecos Valley. The various groups form a well-timbered range in the midst of arid plains, carrying a few Mexican or peculiar species or subspecies of animals and plants, but dominated largely by Rocky Mountain species. They rise through the successive zones from Lower Sonoran to Hudsonian.

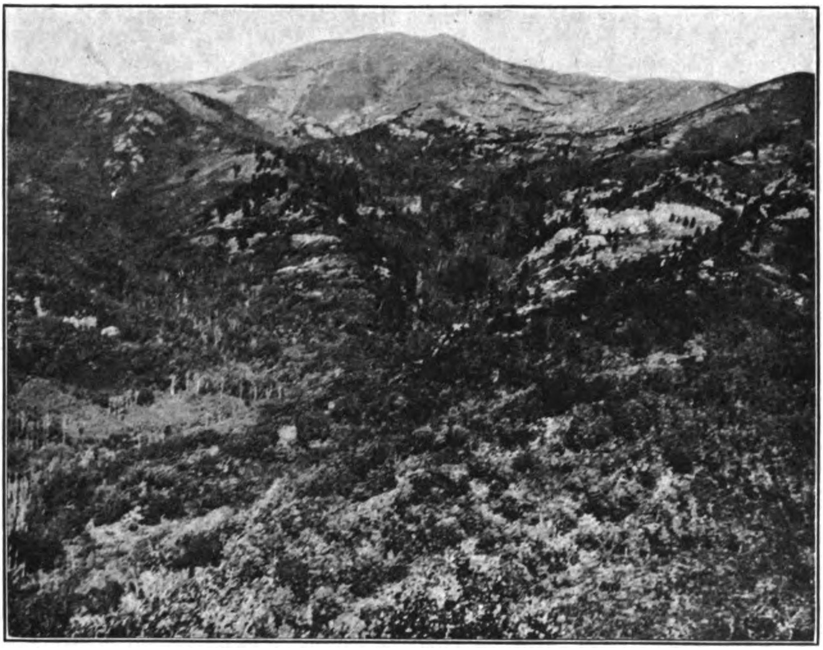

Fig. 5.—Sierra Blanca, or White Mountain Peak, from the southeast, looking over the head of Ruidosa Creek. Timber mainly Douglas spruce and aspens.

The Hudsonian Zone is represented on the top and northeast slope of Sierra Blanca, or White Mountain Peak, by many dwarf plants such as *Silene*, *Arenaria*, *Saxifraga*, *Rhodiola neomexicana*, *Sedum*, *Orthocarpus*, *Erigeron*, *Ligusticum*, and on narrow crests of two lateral ridges by a few dwarf *Picea engelmanni* that reach to within 200 feet of the summit. The whole upper south slope is bald and grassy and the north slope steep and rocky, so that the presence of a true timberline can be inferred only from these narrow strips of spruce.

On September 13, I found Clark's nutcracker, Townsend's solitaire, and the pipit on or near the peak, but practically nothing is known of the breeding birds or of the mammals high up on this mountain. There were numerous burrows and runways of *Microtus* and pocket gophers nearly to the top. My work on the mountains consisted of a single day's trip to the peak and back to my 7,000-foot camp on Ruidoso Creek.

The Canadian Zone covers most of the higher peaks and cold slopes of the Capitan, White, and Sacramento Mountains, and is represented by a trace at the southern end of the Guadalupes. It is a narrow, irregular, and broken area that reaches its full vertical width only on the White Mountains. It is characterized by forests of spruce, fir, and aspens and by many of the Rocky Mountain trees and shrubs of the zone. It is difficult to say whether Douglas spruce and Chihuahua white pine are mainly Canadian or Transition, as they occur in both zones. Rocky Mountain maple is common in places and *Pachystima myrsinites* and several species of *Ribes* are common in the zone. The mammals of the Canadian Zone of this range are the mule deer, spruce squirrel, gray-footed chipmunk, long-tailed meadow mouse, white-footed mouse, porcupine, fulvous pocket gopher, and a small shrew. Some of the breeding birds are the long-crested jay, red crossbill, pine siskin, red-backed junco, Audubon's hermit thrush, broad-tailed hummingbird, western flycatcher, and brown creeper.

Throughout this zone of cool coniferous forests are numerous open parks and spruce-bordered grassy gulches where springs and little streams afford conditions for delightful summer camps. For the people of southeastern New Mexico and much of western Texas it is the most convenient resort during the long hot summers. Railroads and wagon roads make the mountains easy of access at many points and the national forests should insure the protection of this natural park region. Only a few years ago it was famous for its variety and abundance of game, especially elk, mule deer, white-tailed deer, antelope, bighorn, black and silver-tip bears, and wild turkeys. The elk are now exterminated and other game birds and animals are becoming scarce, but it is hoped that they can be protected so that present numbers at least shall be maintained.

The Transition Zone in these mountains covers a wide plateau and is almost continuous for the whole length of the range. It reaches from about 6,500 to 8,000 feet altitude on northeast slopes and from 7,500 to 9,500 feet on southwest slopes. On some very steep southwest slopes it reaches from 8,000 to 10,000 feet. It includes wide stretches of beautiful forest, open, clean, and grassy underneath the smooth-trunked yellow pines which dominate the forest. Some Douglas spruce, white pine, large-leaved maple, New Mexico oak, and locust occupy secondary places in this forest. There are extensive open parks or grassy glades and along some of the stream valleys these are occupied by little farms, but the great value of this zone is its timber, grass, and water, its cool climate, shade, and beauty in the midst of a wide expanse of low hot plains.

Its characteristic mammals are white-tailed and mule deer, two species of chipmunks, a 13-lined ground squirrel, Colorado wood rat, Guadalupe meadow mouse, fulvous pocket gopher, mountain cottontail, and brown bat. Some of the breeding birds of the Transition Zone are the wild turkey, band-tailed pigeon, Huachuca spotted owl, screech owl, hairy woodpecker, ant-eating woodpecker, red-shafted flicker, broad-tailed hummingbird, green-tailed and spurred towhees, western tanager, Audubon's and Grace's warblers, pygmy and Rocky Mountain nuthatches, western robin, and chestnut-backed bluebird.

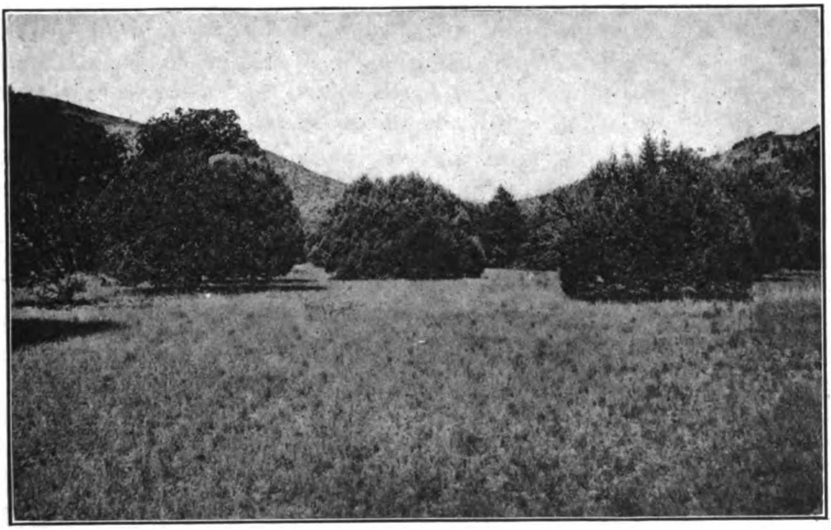

FIG. 6.—Checker-barked junipers in Dog Canyon in the Guadalupe Mountains.

The Upper Sonoran Zone covers the lower slopes of the Sacramento Range, including the foothills and many long spurs and ridges. The arid slopes are usually steep and either bare or densely covered with juniper, nut pine, scrub oak, and other chaparral. Water is scarce, especially on the west slope of the range, and extensive areas are uninhabited. Some of these densely clothed and almost impenetrable slopes and canyons provide safe cover and abundant food supply for deer, bears, Mearns's quail, and other animals, and have played an important part in keeping up the supply of game. The steeper and barer slopes along the southern part of the range are still the home of the Mexican bighorn, which, under the double advantage of favorable environment and legal protection, is apparently on the increase.

Other more open foothill valleys in the Upper Sonoran Zone lie along streams such as the Peñasco, Felix, Ruidosa, Bonito, and Tularosa, and are important agricultural areas.

IMPROVEMENT OF STOCK RANGES.

Many of the arid valleys in New Mexico have been for years so overstocked that the best grasses have been killed out and parts of the range rendered almost worthless. Some of the valleys show mile after mile of ground almost bare or overgrown with worthless vegetation that stock does not eat. Around most of the watering places the grass is killed for a long distance, often from 1 to 3 miles, the ground is trampled and baked, and the little rain that falls runs down the trails and is wasted. All of the public stock range[1] needs protection, and some of it needs reseeding. Over a great part of the privately owned range simple methods can be employed to improve the grass and greatly increase the grazing capacity. Grass is generally the best on very gentle slopes and poorest on steep slopes or on flooded bottoms. In most of the valley country there is at best not enough rain for a complete soil cover of grass and on the half-bare sloping sides of the valleys a great part of the water that falls quickly runs off. If this water could be held where it falls and be well distributed in the soil the grass crop would in many places be greatly increased.

Good results have been obtained on a small scale by simple and inexpensive methods that ranchmen could easily adopt on their own land. Contour furrows (or furrows plowed on a level), 4 to 6 feet apart along the sloping side of a valley, will hold most of any ordinary rain and take the water into the ground in such a way as to do the greatest good and also retain the richness of the soil.

The numerous small water channels cutting down the side slopes of the valleys can be closed at intervals so as to throw the water out through diverging furrows over side slopes and redistribute that which has come down from higher slopes. Each arroyo should thus arterially distribute water along its way instead of sucking it in from countless capillaries.

If watering places were provided at more uniform intervals over the range, the grass would not be destroyed in some places and allowed to go to waste in others. Even small reservoirs or cemented cisterns that would supply water for a month or more after each rain would serve this purpose. Where good water is to be had at a reasonable depth, wells and windmills are of course simple means of supplying water, but there are extensive areas where subterranean water has not been obtained and reservoirs are the only possible substitute.

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[1] For a comprehensive treatment of the range problem in New Mexico, see Bull. 66, N. Mex. Agric. Exp. Sta., by E. O. Wooton, 1908.

Prairie dogs, rabbits, and the big kangaroo rats should not be allowed to multiply on good stock range. They consume and destroy a large amount of grass and keep wide spaces about their burrows bare and nonproductive. They are easily destroyed at very small expense. Pocket gophers are a decided benefit to range land and need not be destroyed except along ditches or on cultivated ground.

BIBLIOGRAPHY.

The following titles of publications bearing upon the life zones and distribution areas in New Mexico include those most likely to interest the general reader. The list relating to each of the subjects included could be extended, and other fields of animal life could be drawn upon. Each definite and reliable record of a species is of value in locating the extent or boundary of some distribution area, but articles of minor importance are too numerous for citation here. Some of the local lists have been of great assistance in providing material for the present report, but the main sources of information have been the specimens and the unpublished field reports of the Biological Survey.

1848. ABERT, J. W. Notes of Lieut. J. W. Abert. (App. No. 6 to Notes of a Military Reconnoissance from Fort Leavenworth, in Missouri, to San Diego, in California, by W. H. Emory.) House Exec. Doc. No. 41, 30th Cong., 1st Sess., pp. 386–414.

With notes on distribution of plants along the route through New Mexico.

1848. ABERT, J. W. Report of Lieut. J. W. Abert of his Examination of New Mexico, in the years 1846–47. House Exec. Doc. No. 41, 30th Cong., 1st Sess., pp. 417–548, with map. Printed also in Senate Doc. No. 23, 30th Cong., 1st Sess., pp. 1–132.

Contains numerous notes on mammals, birds, and plants.

1848. WISLIZENUS, A. Memoir of a Tour to Northern Mexico, connected with Col. Doniphan's Expedition, in 1846 and 1847. Sen. Misc. Doc. No. 26, 30th Cong., 1st Sess., pp. 1–141.

Contains numerous notes on the botanical and general features of the route through New Mexico.

1851. McCALL, GEO. A. Some Remarks on Habits, etc., of Birds Met with in Western Texas between San Antonio and the Rio Grande, and in New Mexico; with descriptions of several species believed to have been hitherto undescribed. <Proc. Acad. Nat. Sci. Phila., V, pp. 213–224.

Contains many notes on distribution, abundance, and habits of the 68 species enumerated.

1853. SITGREAVES, L. Report of an Expedition down the Zuni and Colorado Rivers in 1851. Pub. by Engineer Bureau; and in Vol. 10, Sen. Exec. Doc. 32d Cong., 2d Sess., 198 pages.

Report on Natural History by S. W. Woodhouse and others, pp. 31–178, contains lists of mammals, birds, reptiles, batrachians, fishes, and plants.

1855. **Henry, T. Carlton.** Notes Derived from Observations Made on the Birds of New Mexico during the years 1853 and 1854. <Proc. Acad. Nat. Sci. Phila., VII, pp. 306–317.

Notes on the country and on 170 species of birds found at Forts Fillmore and Thorn (on the Rio Grande) and at Fort Webster (near Santa Rita).

1856. **Torrey, John.** Description of the General Botanical Collections [of Whipple's Expedition]. Rept. Expl. and Surv. R. R. Pac., IV, pp. 59–182.

Includes many notes upon the flora of New Mexico.

1857. **Engelmann, George.** Synopsis of the Cactaceae of the United States and Adjacent Regions. <Proc. Am. Acad. Arts and Sciences, III, pp. 259–314.

Under headings Geography of the Cactus Region of the United States (p. 311) and Geographical Distribution of the Cactaceæ in the Territory of the United States (p. 312), his Texas Region, New Mexican Region, and Gila Region include much of New Mexico.

1859. **Baird, Spencer F.** Mammals of the Boundary. First article, pp. 1–62, with 27 plates, in Part 2 of Vol. 2 of Report of the U. S. and Mexican Boundary Survey, under Lieut. Col. W. H. Emory.

Contains numerous records and notes on distribution of species in New Mexico.

1859. **Baird, Spencer F.** Birds of the Boundary. Second article, pp. 1–32, with 25 plates, in Part 2 of Vol. 2 of Report of the U. S. and Mexican Boundary Survey, under Lieut. Col. W. H. Emory.

Contains many New Mexico records and notes on distribution.

1859. **Baird, Spencer F.** Reptiles of the Boundary. Third article, pp. 1–35, with 41 plates, in Part 2 of Vol. 2 of Report of the U. S. and Mexican Boundary Survey, under Lieut. Col. W. H. Emory.

Contains some notes on distribution of species in New Mexico.

1859. **Girard, Charles.** Ichthyology of the Boundary. Fourth article, pp. 1–85, with 41 plates, in Part 2 of Vol. 2 of Report on the U. S. and Mexican Boundary Survey, under Lieut. Col. W. H. Emory.

A very few of the records are from New Mexico specimens.

1859. **Le Conte, J. L.** The Coleoptera of Kansas and Eastern New Mexico. <Smiths. Contrib. Knowl., XI, pp. 1–58, pl. 1–2.

With a large colored map of the "Entomological Provinces of North America."

1861. **Cooper, J. G.** The Forests and Trees of Northern America, as Connected with Climate and Agriculture. Rept. of Commissioner of Patents (Agriculture) for the year 1860. House Doc. No. 48, 36th Cong., 2d Sess., Vol. 8, 1860–61, pp. 416–445, with a map showing distribution of North American forests.

Names and outlines many distribution areas as based on distribution of trees and shrubs. Makes the "Arizonan" a distinct region including New Mexico and belonging to the "Mexican Province," and gives both upper and lower Sonoran plants as characteristic.

1866. **Cope, E. D.** On the Reptilia and Batrachia of the Sonoran Province of the Nearctic Region. <Proc. Acad. Nat. Sci. Phila., 1866, pp. 300–314.

With special lists (pp. 311–313) of species and genera characteristic of different districts.

1871. **Allen, J. A.** Mammals and Winter Birds of East Florida with an Examination of Certain Assumed Specific Characters in Birds and a Sketch of the Bird Faunae of Eastern North America. <Bull. Mus. Comp. Zool., II, No. 3, pp. 161–450.

The comparison of colors of species from arid and humid regions treated under individual and geographical variation among birds (pp. 186–250) applies to a large number of New Mexico species.

1873. **Binney**, W. G. Catalogue of the Terrestrial Air-breathing Mollusks of North America, with Notes on their Geographical Range. <Bull. Mus. Comp. Zool., III, pp. 191–220.

With a colored map showing distribution areas.

1875. **Cope**, E. D. On the Geographical Distribution of the Vertebrata of the Regnum Nearcticum, with Especial Reference to the Batrachia and Reptilia. <Bull. No. 1, U. S. Nat. Mus., Part III, pp. 55–95.

Many New Mexico species are included in the lists characterizing the Central and Sonoran subdivisions of the Nearctic faunal region.

1875. **Coues**, E., and **Yarrow**, H. C. Report on Collections of Mammals made in portions of Nevada, Utah, California, Colorado, New Mexico, and Arizona during the years 1871, 1872, 1873, and 1874. <Rept. Geol. and Geog. Expl. West of 100th Mer., V, pp. 37–129.

1875. **Yarrow**, H. C. Notes upon Geographical Distribution and Variation, with Regard to the Zoology of the Western United States as Relates more Particularly to Mammals and Birds. <Rept. Geog. and Geol. Expl. and Surv. West of 100th Mer., V, Zool., pp. 23–24, 1875.

Mainly quoted from Allen.

1878. **Packard**, A. S., Jr. Some Characteristics of the Central Zoo-geographical Province of the United States. <Amer. Nat., XII, pp. 512–517.

Includes New Mexico.

1884. **Sargent**, C. S. Report on the Forests of North America (exclusive of Mexico). Rept. Tenth Census, IX, pp. 612.

The forests of New Mexico are treated specifically on p. 568 with a map showing their distribution.

1885. **Batchelder**, **Charles** F. Winter Notes from New Mexico. <Auk, II, pp. 121–128 and 233–239. Annotated list of birds found about Las Vegas Hot Springs in December, 1882, with notes on the general features of the country.

1885. **Binney**, W. G. A Manual of American Land Shells. <Bull. No. 28, U. S. Nat. Mus., 528 pp.

Contains a chapter (pp. 18–42) on "Geographic Distribution." Applies to New Mexico only in a very general way.

1885–6. **Henshaw**, H. W. List of Birds Observed in Summer and Fall on the Upper Pecos River, New Mexico. <Auk, II, pp. 326–333, July, 1885; and III, pp. 73–801, January, 1886.

Contains notes on 83 species and subspecies of birds found along the Pecos River east of Santa Fe, July 18 to October 28, 1883, by H. W. Henshaw and E. W. Nelson, with a description of the country.

1886. **Vasey**, **George**. Report of an Investigation of the Grasses of the Arid Districts of Kansas, Nebraska, and Colorado. Bull. No. 1, Div. Botany, U. S. Dept. Agric., 18 pp.

Includes notes on northeastern New Mexico.

1888. **Rusby**, H. H. General Floral Features of the San Francisco and Mogollon Mountains of Arizona and New Mexico and their Adjacent Regions. <Trans. N. Y. Acad. Sci., VIII, pp. 76–81.

1889. **Ensign**, **Edgar** T. Report on the Forest Conditions of the Rocky Mountains, especially in the State of Colorado, the Territories of Idaho, Montana, Wyoming, and New Mexico. Bull. No. 2, Div. of Forestry, U. S. Dept. Agric., pp. 41–152.

With folded map showing forest areas in the Rocky Mountain Region, including New Mexico. Distribution of forest trees given by counties.

1890. **Merriam**, C. **Hart**. Results of a Biological Survey of the San Francisco Mountain Region and Desert of the Little Colorado, Arizona. North Amer. Fauna No. 3, 136 pp., five colored maps, Sept. 11, 1890.

Extensive discussion of life zones. The first detailed life zone work in a region bordering on New Mexico.

1892. Allen, J. A. The Geographical Distribution of North American Mammals. <Bull. Amer. Mus. Nat. Hist., IV, pp. 199-243, pls. V-VIII.

With four colored maps of North America.

1892. Anthony, A. W. Birds of Southwestern New Mexico. <Auk, IX, pp. 357-369.

An annotated list of 129 species and subspecies of birds found in the Apache Hills and surrounding country near the Mexican line in Grant County during parts of 1886 and 1889, with a brief description of the country.

1892. Merriam, C. Hart. The Geographical Distribution of Life in North America, with Special Reference to the Mammalia. <Proc. Biol. Soc. Wash., VII, 64 pp., with colored zone map of North America. (Republished in 1893 in Ann. Rept. Smithsonian Inst. for 1891, pp. 365-415, without map.)

Gives general principles of distribution in North America, also tables of names proposed by earlier authors for the various distribution areas. The discussion of the Sonoran division and its synonyms (p. 15) applies particularly to New Mexico.

1893. Allen, J. A. The Geographical Origin and Distribution of North American Birds, Considered in Relation to Faunal Areas of North America. <Auk, X, pp. 97-150, pls. III-IV.

With two colored faunal maps of North America.

1893. Coville, F. V. Botany of the Death Valley Expedition. <Contr. U. S. Nat. Herb., IV, 363 pp.

Contains chapters on the Principles of Plant Distribution and on Distribution of Plants in Southeastern California.

1893. Merriam, C. Hart; and others. The Death Valley Expedition, a Biological Survey of Parts of California, Nevada, Arizona, and Utah. North American Fauna No. 7, Part II.

The field notes on the zonal distribution of reptiles and batrachians (pp. 159-228) and the notes on the geographical and vertical distribution of trees, shrubs, cactuses, yuccas, and agave (pp. 285-359), by Merriam, give the zones of many species found in New Mexico.

1893. Townsend, C. H. T. On the Life Zones of the Organ Mountains and Adjacent Region in Southern New Mexico, with Notes on the Fauna of the Range. <Science, XXII, pp. 313-315.

Distinguishes Tornillo or Cottonwood Zone, Mesquite Zone, Juniper or Cedar Zone, and Pine Zone.

1894. Merriam, C. Hart. Laws of Temperature Control of the Geographic Distribution of Terrestrial Animals and Plants. <Nat. Geog. Mag., VI, pp. 229-238, December.

Contains three colored maps of the United States and part of Canada, showing conformity of life zones with isotherms.

1895. Merriam, C. Hart. The Geographic Distribution of Animals and Plants in North America. Yearbook U. S. Dept. of Agric. for 1894, pp. 203-214.

Has map showing life zones of the United States and southern Canada in black and white, and discusses the principles of distribution as illustrated by animals and plants.

1895, 1897. Townsend, C. H. T. On the Bio-geography of Mexico, Texas, New Mexico, and Arizona. With special reference to the limits of the life areas, and a provisional synopsis of the bio-geographic divisions of America. <Trans. Tex. Acad. Sci., I, pp. 71-96, 1895; II, pp. 33-86, 1897.

1896. Cockerell, T. D. A. Report of the Entomologist. Bull. No. 19, New Mex. Agric. Exp. Sta., pp. 99-118.

Pages 99 and 100 on life zones, mainly critical.

1896. Cope, E. D. The Geographical Distribution of Batrachia and Reptilia in North America. <Amer. Nat., XXX, pp. 886-902, and 1003-1026, 1896.

Applies to New Mexico in a very general way.

1897. Cockerell, T. D. A. Life Zones in New Mexico, Pt. I. Bull. No. 24, New Mex. Agric. Exp. Sta., 44 pp.

With tables of the distribution of certain families of insects in New Mexico.

1898. Cockerell, T. D. A. Life Zones in New Mexico, Pt. II. Bull. No. 28, New Mex. Agric. Exp. Sta., pp. 137–179.

Gives zonal distribution of Coleoptera.

1898. Merriam, C. Hart. Life Zones and Crop Zones of the United States. Bull. No. 10, Biological Survey, U. S. Dept. Agric., 79 pp.

Contains colored map of Life Zones of the United States, corrected to December, 1897. Gives lists of native species characterizing the zones and subdivisions and crops best adapted to each division.

1898. Plumb, C. S. The Geographic Distribution of Cereals in North America. Bull. No. 11, Biological Survey, U. S. Dept. Agric., 24 pp.

Contains colored map of Life Zones of the United States, by C. Hart Merriam, and shows adaptation of various varieties of cereals to the different zones and their subdivisions.

1898. Pound, Roscoe; and Clements, F. E. The Vegetation Regions of the Prairie Province. <Bot. Gaz., XXV, pp. 381–394.

The region includes the northeastern part of New Mexico.

1899. Garriott, E. B. Notes on Frost. Farmers' Bulletin No. 104, Weather Bur., U. S. Dept. Agric., 23 pp.

A popular treatment of frost conditions and methods of preventing frost. Many references to thermal belts or verdant zones.

1899. Smith, J. G. Grazing Problems in the Southwest and How to Meet Them. Bull. No. 16, Div. Agrost., U. S. Dept. Agric., 47 pp.

Considerable discussion of New Mexican plants.

1900. Carleton, M. A. The Basis for the Improvement of American Wheats. Bull. No. 24, Div. Vegetable Physiology and Pathology, U. S. Dept. Agric., 87 pp.

With colored map showing distribution of different groups of wheat varieties and areas of irrigated wheat.

1900. Cockerell, T. D. A. The Lower and Middle Sonoran Zones in Arizona and New Mexico. <Amer. Nat., XXXIV, pp. 285–293, 1900.

On zonal positions of the Salt River and Mesilla valleys.

1900. Cope, E. D. The Crocodilians, Lizards, and Snakes of North America. <Rept. U. S. Nat. Mus. for 1898, pp. 153–1244, pls. 1–36.

With an extended chapter on geographic distribution (pp. 1199–1234). Applies to New Mexico only in a very general way.

1900. Rydberg, P. A. Plant Geography of North America. Composition of the Rocky Mountain Flora. <Science (new ser.), XII, pp. 870–873, Dec. 7, 1900.

A general discussion of distribution areas, particularly of the Rocky Mountain Region, including New Mexico.

1901. Bray, W. L. The Ecological Relations of the Vegetation of Western Texas. <Bot. Gaz., XXXII, pp. 99–123, 195–217, 262–291, figs. 1–24.

With a map (fig. 6) of the "Vegetation Provinces of the West Texas Region" and considerable discussion of zones and distribution.

1902. Bailey, Florence Merriam. Handbook of Birds of the Western United States. 8vo, xc, 514 pp. Boston.

Map of life zones of Western United States, p. xxxiv; ranges of many species of birds given by zones; and a chapter on zonal distribution.

1903. Brown, A. E. The Faunal Relations of Texas Reptiles. <Proc. Acad. Nat. Sci. Phila., LV, pp. 551–558.

With lists of species characteristic of different zones and faunal districts.

1903. Coville, Frederick V.; and MacDougal, D. T. Desert Botanical Laboratory of the Carnegie Institution. Published by the Carnegie Institution, 58 pp.

Contains an account of the Tularosa Desert and the White Sands, with notes upon their floras.

1903. Stone, Witmer; and Rehn, James A. G. On the Terrestrial Vertebrates of Portions of Southern New Mexico and Western Texas. <Proc. Acad. Nat. Sci. Phila., LV, pp. 16–34, May 7, 1903.

Contains local lists of mammals, birds, and reptiles, mainly from the Sacramento Mountains and Alamogordo Valley, with notes on zonal distribution.

1904. Plummer, Fred G.; and Gowsell, M. G. Forest Conditions in the Lincoln Forest Reserve, New Mexico. Professional Paper No. 33, U. S. Geol. Surv., 47 pp.

The mountains are divided into forest zones; distribution of trees given by townships; timber stands shown on contour maps.

1905. Bailey, V. Biological Survey of Texas. North American Fauna No. 25, Biological Survey, U. S. Dept. Agric., 216 pp., illustrated, Oct. 24, 1905.

Contains an extended chapter, "Fauna and Flora of Texas in Relation to Life Zones and Minor Distribution Areas." Colored map of "Life Zones of Texas and Parts of Oklahoma and New Mexico," and numerous distribution maps.

1905. Bray, W. L. The Vegetation of the Sotol Country in Texas. Bull. No. 60, Univ. Tex., Scientific Series No. 6, 24 pp., 11 plates, June 15, 1905.

Discusses the change from the humid Austroriparian to arid Sonoran division of Lower Austral Zone and names the arid division in West Texas the Sotol Country.

1905. MacBride, T. H. The Alamogordo Desert. <Science (new ser.), XXI, pp. 90–97.

A discussion of the botanical and geological features of the White Sands and the surrounding country.

1905. Rixon, T. F. Forest Conditions in the Gila River Forest Reserve, New Mexico. Professional Paper No. 39, U. S. Geol. Surv., iii+89 pp.

Gives distribution of timber by townships and shows timber stand on contour map of Gila National Forest.

1906. Hilgard, E. W. Soils, their Formation, Properties, Composition and Relation to Climate and Plant Growth in the Humid and Arid Regions. xxvii+595 pp. New York and London.

Contains chapters on Soils of the Arid and Humid Region, Alkali Soils, Utilization and Reclamation of Alkali Lands, the Vegetation of Saline and Alkaline Lands with tables showing tolerance of alkali and salts by native species and by trees and crop plants.

1906. Hunn, John T. Sharpless. Notes on Birds of Silver City, New Mexico. <Auk, XXIII, pp. 418–425.

Comprising notes on 112 species and subspecies of birds found about Silver City from September to May of 1903–4 and 1904–5, and brief notes on general features of the country.

1906. Rydberg, P. A. Flora of Colorado. Bull. No. 100, Colo. Agric. Exp. Sta., 448 pp.

Treats a large part of the species of northern New Mexico, and gives distribution by altitudes and specific localities in Colorado.

1907. Mearns, E. A. Mammals of the Mexican Boundary of the United States. A descriptive catalogue of the species of mammals occurring in that region; with a general summary of the natural history and a list of trees. Bull. No. 56, U. S. Nat. Mus., Pt. I, 501 pp. Families Didelphiidæ to Muridæ.

With chapters on the "Life Areas" and "Differentiation Tracts" (pp. 70–74). Black and white maps of route and of "Differentiation Tracts," and numerous illustrations.

1907. Ruthven, Alexander G. A Collection of Reptiles and Amphibians from Southern New Mexico and Arizona. <Bull. Am. Mus. Nat. Hist., XXIII, pp. 483–604. Illustrated.

A section extending from Cloudcroft on top of the Sacramento Mountains to the White Sands in the bottom of the Tularosa Valley is divided into plant associations with which the reptiles are correlated.

1908. Gilman, M. French. Birds of the Navajo Reservation in New Mexico. <Condor, X, pp. 146–152.

A list of the birds observed about Shiprock Agency in the San Juan River Valley and in the Chusca Mountains of Northwestern New Mexico between February 1 and September 1, 1907, with notes on distribution, abundance, and habits; notes on general features of the country.

1908. Ruthven, Alexander G. Variation and Genetic Relationships of the Garter Snakes. Bull. No. 61, U. S. Nat. Mus., 201 pp.

With distribution maps of most of the species.

1908. Wheeler, William Morton. The Ants of Texas, New Mexico, and Arizona. <Bull. Am. Mus. Nat. Hist., XXIV, Art. 21, pp. 399–485.

The distribution of many of the species conform closely to life zones.

1908. Wooton, E. O. The Range Problem in New Mexico. Bull. No. 66, New Mex. Agric. Exp. Sta., 46 pp.

Contains many notes upon the occurrence of native plants and a map showing the distribution of grass societies in the State.

1909. Blaisdell, Frank E. A Monographic Revision of the Coleoptera belonging to the Tenebrionide Tribe Eleodiini inhabiting the United States, Lower California, and Adjacent Islands. Bull. No. 63, U. S. Nat. Mus., 524 pp., and 13 plates.

The detailed ranges given show that many species conform to life zones.

1909. Standley, Paul C. Notes on the flora of the Pecos River National Forest. <Muhlenbergia, V, pp. 17–30.

1910. American Ornithologists' Union Committee. Check List of North American Birds. Third edition (revised), New York.

The frontispiece is a map of North America showing life zones in colors prepared by Merriam, Bailey, Nelson, and Preble, and zones are used in defining ranges of most of the species.

1910. Mead, I. R. Study of the Life of the Tornillo Zone. Thesis, New Mexico Agricultural College. MS. in library New Mex. Agric. College. (From Standley.)

"Contains the results of observations upon the plants and insects of certain parts of Mesilla Valley."

1910. Metcalfe, O. B. A Study of the *Atriplex* and *Larrea* Tension Line in the Mesilla Valley, New Mexico. Thesis for the degree of M. S., New Mexico Agricultural College. MS. in library New Mex. Agric. College. (From Standley.)

"An account of the results of efforts to explain the peculiar distribution of *Covillea tridentata* and *Atriplex canescens* in the Mesilla Valley."

1910. Metcalfe, O. B. The Flora of the Mesilla Valley. Thesis for the degree of B. S., New Mexico Agricultural College. MS. in library New Mex. Agric. College. (From Standley.)

"A discussion of the zones of plant life to be found in the region, together with a list of the plants occurring in the vicinity."

1910. Standley, Paul C. The Type Localities of Plants First Described from New Mexico. <Contr. Nat. Herb., XIII, pp. 143–227.

With two maps of New Mexico, lists of the plants described from each type locality, and a bibliography of New Mexican botany.

1911. BOWMAN, ISAIAH. Forest Physiography, Physiography of the United States, and Principles of Soils in Relation to Forestry. 8vo. 759 pp. Many figures, plates, and a geological map of North America. New York.

Numerous physiographic areas are named and defined.

1911. CARY, MERRITT. A Biological Survey of Colorado. North American Fauna No. 33, Biological Survey, U. S. Dept. Agric., 256 pp.

Colored zone map of Colorado, species maps and lists of zone-marking species of mammals, birds, reptiles, and plants.

1911. SHANTZ, H. L. Natural Vegetation as an Indicator of the Capabilities of Land for Crop Production in the Great Plains Area. Bull. No. 201, Bur. Plant Industry, U. S. Dept. Agric., 100 pp., numerous illustrations.

This report is especially applicable to the Great Plains division of Upper Sonoran Zone in eastern New Mexico.

1911. WOOTON, E. O. Cacti in New Mexico. Bull. No. 78, New Mex. Agric. Exp. Sta., pp. 1–70.

All of the known species in New Mexico are described; ranges are given by zones.

1911. HARSHBERGER, JOHN WILLIAM. Phytogeographic Survey of North America. 790 pp., colored map, numerous illustrations, and bibliography (46 pages). New York and Leipzig.

A compilation based on numerous reports on distribution of plants. On the map New Mexico includes parts of three divisions—his Prairie-Great Plains Region, Great Basin Region, and Rocky Mountain Region.

1913. WOOTON, E. O.; and STANDLEY, PAUL C. Description of New Plants, Preliminary to a Report on the Flora of New Mexico. <Contr. Nat. Herb. XVI, Pt. 4, pp. 109–196.

A large number of new species described; distribution given by specific localities and by life zones.

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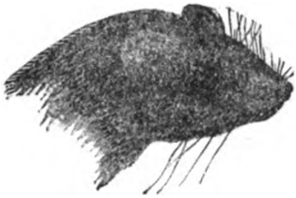

REVISION OF THE AMERICAN HARVEST MICE

(Genus REITHRODONTOMYS)

BY

ARTHUR H. HOWELL
ASSISTANT BIOLOGIST, BIOLOGICAL SURVEY

WASHINGTON
GOVERNMENT PRINTING OFFICE
1914

LETTER OF TRANSMITTAL.

United States Department of Agriculture,
Bureau of Biological Survey,
Washington, D. C., January 3, 1914.

Sir: I have the honor to transmit herewith, for publication as North American Fauna No. 36, the results of a study of the American harvest mice by Arthur H. Howell, assistant biologist, Biological Survey.

The American harvest mice occur abundantly in or near meadows and cultivated lands over a large part of the United States. Their exact economic relations are still little known, but they belong to a group of mammals many species of which are injurious to agriculture, and there is no doubt that they consume large quantities of forage and some grain.

Up to the present time the relationships and distribution of the many species have been imperfectly understood. The present report furnishes for the first time a complete systematic synopsis of the group, with maps showing the ranges of the species of most economic importance.

Respectfully,
H. W. Henshaw,
Chief, Biological Survey.

Hon. David F. Houston,
Secretary of Agriculture.

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REVISION OF THE AMERICAN HARVEST MICE.

(Genus REITHRODONTOMYS.)

By ARTHUR H. HOWELL.

INTRODUCTION.

HISTORY AND MATERIAL.

The mice of this genus have been known to naturalists since the days of Audubon and Bachman. At that time only a single species, the eastern harvest mouse, was known, it having been described by Bachman in 1841 under the name of *Mus humulis* from specimens collected near Charleston, S. C. The following year (1842) the same authors redescribed this species as *Mus lecontii* from a specimen collected by Maj. John Leconte in Liberty County, Ga.

Although the species was known from only a few localities (Georgia, South Carolina, and Virginia), and considered rare, its habits were quite fully described by Bachman in "Quadrupeds of North America," published in 1851. The spelling of the name was there changed to "*humilis.*" Even at that time Bachman appreciated the fact that this species was not closely related to true *Mus*, as is indicated by the following statement:

> In examining the teeth of this species, we have found that the tuberculous summits on the molars were less distinct than in those which legitimately belong to the genus *Mus*, and that there are angular ridges on the enamel by which it approaches the genus *Arvicola;* it is in fact an intermediate species, but in the aggregate of its characteristics perhaps approaches nearest to *Mus*, where we for the present have concluded to leave it.[1]

His keenness in noting the distinction between the molars of the harvest mouse and of *Mus* makes his failure to mention the grooving of the incisors all the more remarkable, but as pointed out by Osgood[2] the rest of the description fits the species so well that there can be no doubt of the applicability of the name *humulis* to the harvest mouse of the Atlantic coast.

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[1] Aud. & Bach., Quad. N. Am., II, 1851, p. 106.

[2] Proc. Biol. Soc. Wash., XX, 1907, pp. 49–50.

In 1853 Leconte pointed out that "*Mus Lecontei* of Bachman is a *Reithrodon*, and neither a *Mus* nor a *Hesperomys*."[1]

In 1855 Baird described a second species in the genus, *Reithrodon montanus*, based on a single specimen collected on one of the Government exploring expeditions in the Rocky Mountains, the exact locality being unknown. This specimen remained unique in collections for over 50 years, and not until 1907 was a series of topotypes secured, making possible accurate characterization of the species. In his great work on the "Mammals of North America," published in 1857, Prof. Baird recognized four valid species—*humilis* and *montanus*, already described, and *megalotis* and *longicauda*, proposed as new, the range of the genus being extended to the Mexican border and to the coast of California. A fifth species, *R. carolinensis* (Aud. & Bach.), was provisionally recognized.

Baird realized that considerable differences existed between true *Reithrodon* of South America and the North American mice placed in the same genus, but as he had never seen either skins or skulls of the former, he found it impossible to indicate the discrepancies.

In 1860 De Saussure described a species from Vera Cruz, Mexico, as *R. mexicanus* and the next year another, *R. sumichrasti*, also from Mexico but without definite locality.

In 1874 Coues published a synopsis of the genus,[2] pointing out the characters which distinguish it from true *Reithrodon* and proposing the name *Ochetodon* for the North American species. Five species were recognized in this paper—*humilis*, *longicauda*, *mexicanus*, *montanus*, and *sumichrasti*, the last two provisionally. *R. megalotis* was placed in synonymy under *humilis*. Using practically the same material, he published in 1877 a more detailed revision of the genus[3] in which he recognized only four species, having dropped *O. sumichrasti* even from synonymy.

The name *Ochetodon* quickly became current, American naturalists having overlooked the name *Reithrodontomys* proposed by Giglioli some months earlier than *Ochetodon*, and not until Merriam called attention to this fact in 1892,[4] was the earlier name given precedence.

In 1893 Allen revived the names *megalotis* and *montanus*, placing them formally in the genus *Reithrodontomys* and naming a new form, *R. aztecus*, from New Mexico.[5]

In 1895 Allen published an extended revision of the genus[6] in which he recognized 15 forms, 8 of which were there first described, and the range of the genus was shown to extend practically across the continent from the Carolinas to California and south to Costa Rica. Of the 15 forms recognized, three (*nebrascensis*, *deserti*, and *pallidus*) are considered synonyms by the present writer. Dr. Allen's material consisted of 920 specimens, chiefly from the United States. The paucity of material from southern Mexico, where the genus reaches its highest development, of course accounts for the incompleteness of this revision in so far as the southern forms are concerned. Only 2 specimens from southern Mexico and 17 from Costa Rica were at that time available—only 19 specimens from a region where over 35 subspecies are now known.

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[1] Proc. Acad. Nat. Sci. Phila., 1853, p. 410.

[2] Proc. Acad. Nat. Sci. Phila., 1874, pp. 184-186.

[3] Mon. N. Am. Rodentia, Rept. U. S. Geol. Surv. Terr., XI, 1877, pp. 120-130.

[4] Proc. Biol. Soc. Wash., VII, 1892, p. 26.

[5] Bull. Am. Mus. Nat. Hist., V, 1893, p. 79.

[6] Bull. Am. Mus. Nat. Hist., VII, 1895, pp. 107-143.

As a result of increased activity in the collection and study of North American mammals, new species were discovered almost every year. In 1898 Thomas described *R. söderströmi* from Ecuador, thus extending the range of the genus into South America. In 1901 Merriam published a paper[1] giving descriptions of 23 new forms, based chiefly on the unexampled collections of Nelson and Goldman in Mexico and Guatemala. Since that date 9 additional species have been described, bringing the total number of named forms up to 67, of which 16 are at present regarded as synonyms. Fifty-eight forms are recognized in the present revision, of which 7 are here described as new.

The material on which the present revision is based consists of 2,280 specimens contained in the collections of the United States National Museum, including that of the Biological Survey, and the Merriam Collection. This material has been supplemented by a considerable number of specimens borrowed from other American museums, thus bringing the total number of specimens examined up to 2,583. All the existing types have been examined with the exception of *R. tenuis*, *R. söderströmi*, and *R. modestus*, which are in the British Museum, and *R. mexicanus* and *R. sumichrasti*, which are in the Geneva Museum. Of the last two I have seen photographs of the type skulls, while of *tenuis* and *modestus* I have examined practical topotypes. The National Museum collections contain representatives of all but 5 or 6 of the recognized forms and in most cases considerable series showing all ages and pelages.

In this connection I wish to acknowledge the kindness of the following gentlemen, who have generously loaned from the collections under their charge such material as was needed to supplement the collections in the National Museum: Dr. J. A. Allen, of the American Museum of Natural History; Mr. Outram Bangs, of the Museum of Comparative Zoology; Mr. F. J. V. Skiff, of the Field Museum of Natural History; Mr. Witmer Stone, of the Academy of Natural Sciences of Philadelphia; and Mr. Joseph Grinnell, of the Museum of Vertebrate Zoology, Berkeley, Cal. I am indebted, also, to Mr. Gerrit S. Miller, jr., and Mr. Ned Hollister for valuable criticism.

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[1] Proc. Wash. Acad. Sci., III, 1901, pp. 547–558.

DISTRIBUTION.

The genus *Reithrodontomys* is clearly of Austral origin, being most abundant and highly developed in southern Mexico.

In western North America the typical subgenus ranges practically throughout the Upper and Lower Austral Zones, the northern limits of its range being indicated by the following localities where specimens have been taken: Prescott, Wash.; Custer, Mont.; and Fort Clark, N. Dak. East of the Mississippi River its range is more restricted, and so far as known the genus does not occur north of the Ohio and Potomac Valleys, the most northerly records being at Ceredo, W. Va., and Falls Church, Va. Southward the subgenus *Reithrodontomys* ranges through Mexico and Central America to Panama, but it is not known from South America.

The subgenus *Aporodon* [1] ranges from central Mexico (Jalisco and Vera Cruz) south throughout Central America and thence to Ecuador, its exact limits being very imperfectly known.

In the United States the genus is confined to the Austral Zones, but in Mexico and Central America ranges from the Tropical at or near sea level through all the zones to and including the Canadian at timber line.

HABITS AND ECONOMIC STATUS.

The harvest mice are preëminently field mice. Practically all the known species live in more or less open grassy situations and are partial to neglected fields overgrown with grasses or sedges and to weedy and grassy borders of cultivated tracts. Many species seem to prefer moist situations, and some (as *R. raviventris*) live exclusively in wet marshes, either salt or fresh; others (notably *R. albescens* and *R. montanus*) are found only in dry, sandy uplands. In the arid West in general harvest mice are most often taken along the grassy borders of sloughs, small streams, or irrigation ditches; but they may be found in almost any situation where there is sufficient cover of vegetation to hide them from their enemies.

Certain Mexican and Central American species ascend the mountains to timber line and live in grassy openings or among brush in the more open parts of the forest. *R. söderströmi*, of South America, is described as living in gardens among climbing plants.

Some species, and perhaps all, construct substantial nests of grasses, often lined with soft materials and placed either on the ground or in vines, bushes, or low trees some distance above the ground. Deserted birds' nests are sometimes used as a base for the nest of the mouse. Mr. H. P. Attwater has found their nests in old woodpecker holes in fence posts, and Mr. Howard Lacey, at Kerrville, Tex., has found them on cornstalks and made of corn silk. The breeding season extends in northern latitudes from April to October and in tropical regions may cover the entire year. The number of young produced at a birth varies from three to seven.

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[1] See page 63.

All the species live chiefly above ground, but burrows are also used, and cracks and openings in the ground are often occupied by the nests. The mice sometimes travel in narrow beaten paths of their own, and also are caught in the runways of other mammals, particularly those of cotton rats (*Sigmodon*) and meadow mice (*Microtus*). They are both nocturnal and diurnal in habit and remain active during the entire year.

FOOD.

The food of harvest mice consists largely of seeds and grain, with considerable green vegetation and occasionally fruit. Our knowledge of their preferred habitat indicates that most of their food must be obtained from wild plants of little or no value to man.

Bachman, who had studied the habits of the eastern harvest mouse rather closely, writes of it as follows:

> We doubt whether this species is of much injury to the farmer. It consumes but little grain, is more fond of residing near grass fields, on the seeds of which it subsists, than among the wheat fields. We have observed in its nest small stores of grass seeds—the outer husks and other remains of the broom grass (*Andropogon dissitiflorum*)—also that of the crab grass (*Digitaria sanguinalis*), and small heaps of the seeds of several species of *paspalum*, *poa*, and *panicum*, especially those of *panicum Italicum*.[1]

Mr. H. P. Attwater, writing of *Reithrodontomys intermedius*, as observed in Bexar County, Tex., says:

> These mice seem to be fond of peaches, eating the peach and leaving the stone hanging on the tree.[2]

Mr. E. A. Goldman, at Metlaltoyuca, Mexico, captured a specimen of *R. mexicanus goldmani* on a bunch of bananas hanging about 8 feet above the ground.

Only rarely is any damage to crops reported. Mr. C. W. Seegmiller, of St. George, Utah, states that he has known harvest mice to do some damage by climbing grain stalks and cutting off the heads. He has found their nests built several feet from the ground in close-growing clusters of grain stalks. Prof. D. E. Lantz reports that in eastern Kansas *Reithrodontomys dychei* is often found in the fall under shocks of wheat and corn, and in such situations it may be expected to glean some of the grain.

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[1] Aud. & Bach., Quad. N. Am., II, 1851, p. 105.

[2] Allen, Bull. Am. Mus. Nat. Hist., VIII, 1896, p. 236.

Although in most places harvest mice are only moderately numerous, in a few regions they occur in great abundance.

PELAGES.

The mice of this genus usually molt but once a year, normally in the late fall (at least in northern latitudes), but the changes produced in the pelage by wear and fading are so great that the summer pelage of adults differs markedly from their winter pelage. The young are usually less ochraceous and in some species darker than adults, but the difference between young and adults is less marked than in *Peromyscus* and other related genera. Of the forms examined, *R. humulis merriami* presents the greatest differences between young and adults.

Immature or subadult individuals taken in summer and fall always present a fresh, unworn appearance, the color usually being decidedly paler than in fresh winter pelage. Adults taken in midsummer or early fall are almost always in a more or less worn condition—often so much so as to appear "ragged"—but occasionally one may be found in summer in fresh pelage. The fresh, full pelage is retained during most of the winter, and little evidence of wear is seen before March or April. As the tips of the hairs wear off, the pelage in most species becomes redder, and by midsummer the evidences of fading are often pronounced, individuals and local colonies, however, showing marked differences in the amount of wear and the date of its appearance. Excessively worn individuals of certain species (particularly *R. megalotis*) often become very pale and gray.

Specimens showing clearly the process of molting are comparatively rare, and in the majority of cases the molt seems to progress insidiously, new hairs coming in simultaneously over all parts of the body. In a few cases, however, the line of demarcation is plainly evident, new pelage appearing first on the hinder back and along the sides, the fore part of the back being the last portion to be invested. This is equally true of young and adults.[1]

While the fall molt is doubtless normal in northern latitudes, occasional exceptions have been noted, indicating the occurrence (probably abnormal, at least rare) of a spring or midsummer molt. A young adult male specimen of *R. megalotis dychei*, from Meadow, Wyo., taken June 28, 1909, has nearly completed a full molt, the new pelage covering the whole of the anterior portion of the body to the rump, where the old pelage, decidedly redder than the new, remains. A specimen of *R. fulvescens aurantius* (also a young adult male), from Sour Lake, Tex., taken July 18, 1902, shows a fresh, long pelage covering the anterior half of the body. As in the previous instance, the new pelage is darker and more ochraceous (less reddish) than the old. In both examples it will be noticed that the progress of the molt is directly the reverse of the normal autumn molt, the rump being the last part of the body to be invested, instead of the first, as in the usual method.

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[1] Specimens showing this molt are as follows:

R. humulis merriami, ♀ juv., Lexington, Ky., November 19.
R. megalotis longicauda, ♂ ad., Stanford University, Cal., November 7.
R. megalotis aztecus, ♀ subadult, Grand Junction, Colo., November 2.
R. montanus, ♀ ad., Medano Ranch, Colo., November 4.

The molting period of the species inhabiting Mexico and Guatemala is less strictly confined to the autumn, but as a general rule (with many exceptions) individuals taken from December to June show a fuller and fresher pelage than those taken in the other half of the year. In the entire collection from Mexico I have been able to find only two specimens showing a clearly marked molting line. These are both adult males of *R. megalotis alticolus*, taken at La Parada, Oaxaca (in the lower edge of the Transition Zone), August 19, 1894. In these the molt is nearly completed, the new pelage covering the anterior portion of the body to the rump.

Genus REITHRODONTOMYS Giglioli.

Reithrodon Leconte, Proc. Acad. Nat. Sci. Phila., 1853, pp. 410, 413; Baird, Mamm. N. A., 1857, p. 447. (Not *Reithrodon* Waterhouse.)

Reithrodontomys Giglioli, Ricerche intorno alla Distrib. Geog. Gener. <Boll. Soc. Geog. Ital., Roma, XI, May–July, 1874, p. 326. Author's separates dated 1873 (probably dated from first part of paper in Vol. X), repaged, p. 160. (North American members of the genus *Reithrodon;* no species mentioned.)[1]

Ochetodon Coues, Proc. Acad. Nat. Sci. Phila., December 15, 1874, p. 184 (no type selected; species included: *O. humilis*, *O. longicauda*, *O. mexicanus*, *O. montanus*, and *O. sumichrasti*).

Aporodon Howell, *postea*, p. 63. Type, *Reithrodontomys tenuirostris* Merriam.

Remarks.—Since no species were mentioned by Giglioli when he named the genus *Reithrodontomys*, the type must be fixed by subsequent designation. Miller and Rehn[2] have selected *Mus lecontii* Aud. and Bach. [=*R. humulis*] as the type, but this is in violation of Opinion 46 of the International Commission on Zoological Nomenclature, which advises that the species first associated with the name be considered the type.[3] Allen, in 1893, was the first to use the generic name in connection with a specific name, his paper including three species—*R. megalotis*, *R. aztecus*, and *R. montanus*.[4] Since both *megalotis* and *montanus* were published prior to the naming of the genus, either may be selected as the type. I therefore designate *Reithrodon megalotis* Baird as the type of the genus *Reithrodontomys*.

GENERIC CHARACTERS.

Form murine; tail long, always more than one-third, often more than one-half total length, slender, scaly, thinly haired; ears prominent, often large, more or less hairy; soles of hind feet 6-tuberculate; mammæ, 6—P $\frac{1}{1}$, I $\frac{2}{2}$; no cheek pouches. Skull with smoothly rounded braincase, more or less inflated, without prominent ridges; zygomata slender; outer wall of anteorbital foramen a broad thin plate; anterior palatine foramina relatively large, forming long narrow slits separated by a thin septum, slightly narrower anteriorly, terminating about at the plane of anterior border of tooth row; posterior border of palate square, often with a slight median spine, terminating at plane of posterior border of tooth row; pterygoids nearly parallel; audital bullæ more or less inflated, longer than broad, and obliquely situated. Descending process of mandible a broad flattened plate, strongly deflected inward, the lower portion twisted into a nearly horizontal position and the inner margin raised, leaving a distinct depression in the ramus;[1] coronoid process short. Upper incisors with a deep longitudinal groove near the middle of the tooth. Molars brachyodont, tuberculate, the tubercles arranged in two longitudinal series; first upper molar with five principal tubercles, an anterior median one, and two pairs of lateral ones; m^1 and m^2 with or without accessory tubercles or enamel loops in the principal angles; upper molars normally three-rooted, but in some species four-rooted; lower molars two-rooted.

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[1] Elliot in Pub. Field Columb. Mus., Zool. Ser. III, 1903, p. 145, and several times subsequently, spells this name "*Rhithrodontomys*".

[2] Proc. Boston Soc. Nat. Hist., XXX, 1901, p. 95.

[3] Smiths. Inst., Pub. 2060, February, 1912, p. 104.

[4] Bull. Am. Mus. Nat. Hist., V, 1893, pp. 79–80.

List of Species and Subspecies, with Type Localities.

Subgenus REITHRODONTOMYS.

R. humulis group:	
Reithrodontomys humulis humulis (Bachman)	Charleston, S. C.
humulis impiger Bangs	White Sulphur Springs, W. Va.
humulis merriami Allen	Alvin, Tex.
albescens albescens Cary	18 miles northwest of Kennedy, Nebr.
albescens griseus Bailey	San Antonio, Tex.
R. megalotis group:	
Reithrodontomys montanus (Baird)	"Rocky Mountains, latitude 38°" [=San Luis Valley, Colo., near San Luis Lakes].
megalotis megalotis (Baird)	"Between Janos, Sonora [=Chihuahua] and San Luis Spring" [New Mexico].
megalotis aztecus Allen	La Plata, N. Mex.
megalotis dychei Allen	Lawrence, Kans.
megalotis nigrescens nobis	Payette, Idaho.
megalotis longicaudus (Baird)	Petaluma, Cal.
megalotis peninsulæ Elliot	San Quintin, Lower California.
megalotis cinereus Merriam	Chalchicomula, Puebla.

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[1] Less importance is to be ascribed to this character in distinguishing *Reithrodontomys* from *Peromyscus* than the remarks of Baird (Mamm. N. Am., p. 447) and Coues (Mon. N. Am. Rodentia, p. 122) would indicate, for although typical *Peromyscus* differs noticeably on the average from *Reithrodontomys* in the shape of the descending process, yet certain species of the subgenus *Haplomylomys* show practically the same condition as *Reithrodontomys*.

R. megalotis group—Continued.	
Reithrodontomys megalotis saturatus Allen & Chapman	Las Vigas, Vera Cruz.
megalotis alticolus Merriam	Cerro San Felipe, Oaxaca.
megalotis arizonensis Allen	Chiricahua Mountains, Ariz.
megalotis zacatecæ Merriam	Valparaiso Mountains, Zacatecas.
amoles nobis	Pinal de Amoles, Queretaro.
catalinæ Elliot	Santa Catalina Island, Cal.
raviventris raviventris Dixon	Redwood City, Cal.
raviventris halictœes Dixon	Petaluma, Cal.
R. fulvescens group:	
Reithrodontomys fulvescens fulvescens Allen	Oposura, Sonora.
fulvescens tenuis Allen	Rosario, Sinaloa.
fulvescens intermedius Allen	Brownsville, Tex.
fulvescens aurantius Allen	Lafayette, La.
fulvescens difficilis Merriam	Orizaba, Vera Cruz.
fulvescens toltecus Merriam	Tlalpam, D. F., Mexico.
fulvescens helvolus Merriam	Oaxaca, Oaxaca.
fulvescens chiapensis nobis	Canjob, Chiapas.
fulvescens nelsoni nobis	Colima, Colima.
fulvescens mustelinus nobis	Llano Grande, Oaxaca.
amœnus Elliot	Reforma, Oaxaca.
otus Merriam	Sierra Nevada de Colima, Jalisco.
R. rufescens group:	
Reithrodontomys rufescens rufescens Allen & Chapman	Jalapa, Vera Cruz.
rufescens luteolus nobis	Juquila, Oaxaca.
alleni nobis	Mountains near Ozolotepec, Oaxaca.
colimæ colimæ Merriam	Sierra Nevada de Colima, Jalisco; altitude, 12,000 feet.
colimæ nerterus Merriam	Sierra Nevada de Colima, Jalisco; altitude, 6,500 feet.
dorsalis Merriam	Calel, Guatemala.
australis australis Allen	Volcan de Irazu, Costa Rica.
australis modestus Thomas	Jinotega, Nicaragua.

Subgenus APORODON.

R. levipes group:	
Reithrodontomys levipes Merriam	San Sebastian, Jalisco.
hirsutus Merriam	Ameca, Jalisco.
R. chrysopsis group:	
Reithrodontomys chrysopsis chrysopsis Merriam	Mount Popocatepetl, Mexico.
chrysopsis tolucæ Merriam	Volcan Toluca, Mexico.
chrysopsis orizabæ Merriam	Mount Orizaba, Puebla.
perotensis Merriam	Cofre de Perote, Vera Cruz.
R. mexicanus group:	
Reithrodontomys mexicanus mexicanus (De Saussure)	Mountains of Vera Cruz.
mexicanus goldmani Merriam	Metlaltoyuca, Puebla.
mexicanus cherrii (Allen)	San Jose, Costa Rica.
milleri Allen	Munchique, Colombia.
söderströmi Thomas	Quito, Ecuador.
gracilis Allen & Chapman	Chichen Itza, Yucatan.

R. tenuirostris group:

Reithrodontomys tenuirostris tenuirostris Merriam	Todos Santos, Guatemala.
tenuirostris aureus Merriam	Calel, Guatemala.
creper Bangs	Volcan de Chiriqui, Panama.
microdon microdon Merriam	Todos Santos, Guatemala.
microdon albilabris Merriam	Cerro San Felipe, Oaxaca.

Key to Species and Subspecies.[1]

[Based on adults.]

a. Outer wall of anteorbital foramen decidedly broader than width of interpterygoid fossa; upper molars usually without subsidiary enamel loops.[2]
  b. Tail length, 120 mm. or more.
    c. Greatest length of skull more than 24 mm. . . . . *hirsutus* (p. 66).
    cc. Greatest length of skull less than 24 mm.
      d. Dorsal area blackish . . . . . *toltecus* (p. 51).
      dd. Dorsal area not blackish . . . . . *otus* (p. 55).
  bb. Tail length less than 120 mm.
    c. Tail length more than 65 mm.
      d. Ears blackish brown, without ochraceous hairs.
        e. Underparts whitish.
          f. Tail length 100 mm. or more.
            g. Hind foot more than 20 mm . . . . . *tolucæ* (p. 68).
            gg. Hind foot less than 20 mm . . . . . *alleni* (p. 59).
          ff. Tail length less than 100 mm.
            g. Upperparts mainly ochraceous . . . . . *chiapensis* (p. 53).
            gg. Upperparts mainly blackish or brownish.
              h. Paler; sides light ochraceous-buff.
                i. Larger; hind foot more than 18 mm . . . . . *cinereus* (p. 35).
                ii. Smaller; hind foot less than 18 mm.
                  j. Sides of face pure buff (Arizona) . . . . . *arizonensis* (p. 38).
                  jj. Sides of face ochraceous-buff or grayish.
                    k. Tail length more than 80 mm. (Lower California) *peninsulæ* (p. 35).
                    kk. Tail length less than 80 mm.
                      l. Feet gray (California) . . . . . *longicaudus* (p. 33).
                      ll. Feet white . . . . . *nigrescens* (p. 32).
              hh. Darker; sides dark ochraceous-buff or pinkish cinnamon.
                i. Skull length less than 21.5 mm.
                  j. Smaller; hind foot less than 17 mm . . . . . *amoles* (p. 40).
                  jj. Larger; hind foot more than 17 mm . . . . . *halicœtes* (p. 42).
                ii. Skull length more than 21.5 mm.
                  j. Tail length more than 80 mm.
                    k. Breadth of braincase more than 11 mm . . . . . *tolucæ* (p. 68).
                    kk. Breadth of braincase less than 11 mm.
                      l. Skull larger, with wider zygomata . . . . . *dorsalis* (p. 61).
                      ll. Skull smaller, with narrower zygomata . . *saturatus* (p. 36).
                  jj. Tail length less than 80 mm.
                    k. Ear from notch more than 13 mm . . . . . *alticolus* (p. 37).
                    kk. Ear from notch less than 13 mm . . . . . *modestus* (p. 63).
        ee. Underparts ochraceous-buff or pinkish cinnamon.
          f. Tail unicolor or nearly so.
            g. Tail length more than 80 mm . . . . . *rufescens* (p. 56).
            gg. Tail length less than 80 mm . . . . . *raviventris* (p. 41).

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[1] Color comparisons made with Ridgway's "Color standards and color nomenclature" (1912).

[2] Present in *levipes*, *hirsutus*, *chrysopsis*, *tolucæ*, *orizabæ*, and *perotensis*.

ff. Tail distinctly bicolor.
g. Pelage long; upper molars always with subsidiary enamel loops (except in *colimæ*); habitat above 9,000 feet altitude.
h. Braincase flattened.......... *perotensis* (p. 69).
hh. Braincase globular.
i. Larger; tail length more than 95 mm.
j. Breadth of braincase more than 11 mm...... *chrysopsis* (p. 66).
jj. Breadth of braincase less than 11 mm.......... *orizabæ* (p. 69).
ii. Smaller; tail length less than 95 mm.......... *colimæ* (p. 59)
gg. Pelage short; upper molars usually without subsidiary enamel loops; habitat below 9,000 feet altitude.
h. Skull length less than 22 mm.......... *zacatecæ* (p. 39).
hh. Skull length more than 22 mm.
i. Larger; hind foot 20–21 mm.
j. Braincase flattened.......... *luteolus* (p. 57).
jj. Braincase rounded.......... *nerterus* (p. 60).
ii. Smaller; hind foot 18–20 mm.
j. Nasals longer (8–9.7 mm.); black dorsal area well defined.
k. Skull larger, with wider zygomata.......... *dorsalis* (p. 61).
kk. Skull smaller, with narrower zygomata.... *saturatus* (p. 36).
jj. Nasals shorter (7.3–8.8 mm.); black dorsal area not well defined.
k. Tail longer (88–101 mm.); (Mexico)........ *difficilis* (p. 50).
kk. Tail shorter (82–92 mm.); (Costa Rica)...... *australis* (p. 62).
dd. Ears light brown or drab, with ochraceous hairs.
e. Underparts buffy or ochraceous.
f. Skull length more than 22.5 mm.
g. Length of nasals more than 8.5 mm.......... *toltecus* (p. 51).
gg. Length of nasals less than 8.5 mm.......... *levipes* (p. 64).
ff. Skull length less than 22.5 mm.
g. Tail length 105 mm. or more.......... *mustelinus* (p. 54).
gg. Tail length less than 105 mm.
h. Upperparts strongly mixed with blackish.
i. Underparts strongly washed with buff.......... *difficilis* (p. 50).
ii. Underparts faintly washed with buff.......... *aurantius* (p. 48).
hh. Upperparts mainly ochraceous-buff.
i. Larger and paler.......... *tenuis* (p. 45).
ii. Smaller and brighter.......... *nelsoni* (p. 53).
ee. Underparts white.
f. Tail length more than 104 mm.
g. Larger; skull length 23 mm. or more.......... *toltecus* (p. 51).
gg. Smaller; skull length less than 23 mm.......... *helvolus* (p. 52).
ff. Tail length less than 104 mm.
g. Skull length less than 20 mm.......... *amœnus* (p. 55).
gg. Skull length more than 20 mm.
h. Tail length more than 80 mm.
i. Upperparts tawny-ochraceous, or cinnamon mixed with black.
j. Braincase flatter; nasals shorter.......... *chiapensis* (p. 53).
jj. Braincase higher; nasals longer.......... *aurantius* (p. 48).
ii. Upperparts ochraceous-buff or mixed with blackish.
j. Upperparts mainly ochraceous-buff.
k. Sides deep ochraceous-buff.......... *tenuis* (p. 45).
kk. Sides pale ochraceous-buff.

l. Paler; sides of face grayish..............*fulvescens* (p. 43).
ll. Darker; sides of face ochraceous-buff..*intermedius* (p. 47).
jj. Upperparts mainly blackish or brownish.
k. Skull heavy; interpterygoid fossa broad.
l. Paler (less ochraceous).................*intermedius* (p. 47).
ll. Darker (more ochraceous)................*aurantius* (p. 48).
kk. Skull light; interpterygoid fossa narrow....*catalinæ* (p. 40).
hh. Tail length less than 80 mm.
i. Upperparts mainly deep ochraceous-buff....*longicaudus* (p. 33).
ii. Upperparts mainly light ochraceous-buff or brownish.
j. Skull length more than 21.5 mm................*aztecus* (p. 30).
jj. Skull length less than 21.5 mm.
k. Tail longer; ear 12–13 mm.................*megalotis* (p. 26).
kk. Tail shorter; ear 10–11 mm..................*dychei* (p. 30).
cc. Tail length less than 65 mm.
d. Upperparts mainly grayish or light buff, mixed with black.
e. Black dorsal stripe distinct; ears usually with blackish patches.
f. Paler; skull heavier..................................*albescens* (p. 22).
ff. Darker; skull lighter....................................*griseus* (p. 23).
ee. No distinct dorsal stripe; ears without blackish patches.
f. Darker and more ochraceous............................*dychei* (p. 30).
ff. Paler and less ochraceous.
g. Larger; skull broader..............................*megalotis* (p. 26).
gg. Smaller; skull narrower.........................*montanus* (p. 24).
dd. Upperparts mainly blackish or dark brown.
e. Upperparts Prout's brown.
f. Ear from notch 8–9 mm.................................*impiger* (p. 20).
ff. Ear from notch 9–10 mm...............................*humulis* (p. 19).
ee. Upperparts sooty or with blackish stripe................*merriami* (p. 21).
aa. Outer wall of anteorbital foramen usually narrower than width of interpterygoid fossa;[1] upper molars always with subsidiary enamel loops.
b. Skull length more than 25 mm.
c. Upperparts tawny or ochraceous-tawny.
d. Upperparts tawny...*tenuirostris* (p. 78).
dd. Upperparts ochraceous-tawny ....*aureus* (p. 78).
cc. Upperparts mummy-brown (Panama) ....*creper* (p. 79).
bb. Skull length less than 25 mm.
c. Rostrum long and slender; braincase inflated.
d. Darker; underparts (in adult) pinkish cinnamon..........*microdon* (p. 80).
dd. Paler; underparts white..............................*albilabris* (p. 80).
cc. Rostrum short and broad; braincase not inflated.
d. Upperparts tawny or cinnamon-brown.
e. Colors darker; skull smaller..........................*mexicanus* (p. 70).
ee. Colors paler; skull larger.
f. Upperparts bright tawny...................................*cherrii* (p. 73).
ff. Upperparts dull tawny or brownish.
g. Smaller; underparts white ....*milleri* (p. 74).
gg. Larger; underparts buffy.........................*söderströmi* (p. 75).
dd. Upperparts pinkish cinnamon.
e. Skull length less than 23 mm...........................*gracilis* (p. 76).
ee. Skull length more than 23 mm.......................*goldmani* (p. 72).

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[1] In *gracilis* of about equal width or slightly broader.

Subgenus REITHRODONTOMYS Giglioli.

Subgeneric characters.—Enamel pattern of upper molars simple, the first and second each with two outer reëntrant angles, usually without accessory tubercles.[1]

REITHRODONTOMYS HUMULIS GROUP.

REITHRODONTOMYS HUMULIS HUMULIS (Bachman).

EASTERN HARVEST MOUSE.

(Pl. I, fig. 1; Pl. IV, fig. 1.)

Mus humulis Aud. & Bach., Proc. Acad. Nat. Sci. Phila., I, 1841, pp. 97–98.

Mus lecontii Aud. & Bach., Journ. Acad. Nat. Sci. Phila., VIII, 1842, p. 307 (Georgia, taken by Major John Le Conte).

Mus humilis Aud. & Bach., Quad. N. Am., II, 1851, pp. 103–106, Plate LXV.

Reithrodon lecontei Le Conte, Proc. Acad. Nat. Sci. Phila., VI, 1853, p. 413.

Reithrodon humilis Baird, Mamm. N. Am., 1857, p. 448.

Ochetodon humilis Coues, Proc. Acad. Nat. Sci. Phila., 1874, p. 185 [part].

Reithrodontomys humilis Rhoads, Proc. Acad. Nat. Sci. Phila., 1894, p. 161.

Reithrodontomys lecontii Allen, Bull. Am. Mus. Nat. Hist., VII, 1895, p. 116.

Reithrodontomys humilis dickinsoni Rhoads, Amer. Nat., XXIX, 1895, p. 590 (Willow Oak, Florida).

Reithrodontomys humilis Rhoads and Young, Proc. Acad. Nat. Sci. Phila., 1897, p. 309.

Reithrodontomys humulis Osgood, Proc. Biol. Soc. Wash., XX, 1907, pp. 49–50 (name formally reinstated).

Type locality.—Charleston, S. C.

Distribution.—Southeastern United States, east of the Alleghenies, from southern Virginia to central Florida.

Characters.—Size small; color dark brown; skull narrow, with highly arched cranium and heavy rostrum.

Color.—General tone of upperparts about Prout's brown, being a mixture of blackish brown and pinkish cinnamon, usually darkest along median line; underparts ashy, usually with a tinge of light pinkish cinnamon; tail bicolor, fuscous or hair-brown above, grayish white below; ears fuscous or fuscous-black; feet grayish white. Immature specimens are more fuscous above with slight admixture of brown.

Skull.—Braincase narrow, highly arched; rostrum short and broad; nasals broad, ending nearly on a line with end of premaxillæ; zygomata parallel or slightly contracted anteriorly; palatal foramina broadest in the middle, ending posteriorly about on a line with plane of first molars; bullæ rather small and elongated.

Measurements.—Average of 5 adults from Georgia and South Carolina: Total length, 120 (114–124); tail vertebræ, 57 (53–60); hind foot, 16 (15–17); ear, 9.5 (9–10). Average of 8 adults from Dismal Swamp, Va.: 122; 56; 16; (ear) 9.6. Skull: (See table, p. 81).

Remarks.—This little species—the first member of the genus to be described—has a rather extensive range in the South Atlantic States, from southern Virginia to Florida. In Georgia, Alabama, and Florida the typical race shades insensibly into the subspecies *merriami* of the Mississippi Valley. Specimens from North Carolina and Virginia, as might be expected, exhibit the specific characters in their most pronounced form, the color of the upperparts being uniformly brownish. Specimens from Florida are intermediate but nearer on the whole to *humulis*. In a series of three from Kissimmee one is clearly *humulis*, while the others might without impropriety be referred to *merriami*. The skulls, however, are nearer to *humulis*. The type of "*dickinsoni*," from Willow Oak, is a very dark specimen, but is in the uniform sooty pelage indicative of immaturity. It is closely similar to numerous individuals of *merriami* examined from Alabama and Louisiana. A single specimen from Tarpon Springs, however, can be exactly matched by specimens of *humulis* from the coast of Georgia. In the absence of suitable material the west Florida form is provisionally referred to *humulis*, but a larger series may show it to be nearer *merriami*.

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[1] Small tubercles irregularly present in some species, particularly *R. rufescens* and *R. dorsalis*.

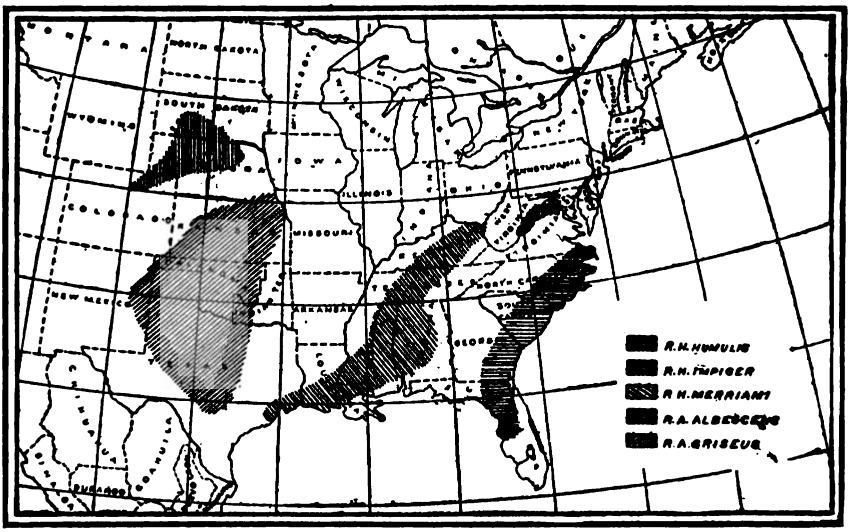

FIG. 1.—Distribution of *Reithrodontomys humulis*, *R. albescens*, and subspecies.

Specimens examined.—Total number, 96, from the following localities:

Virginia: Dismal Swamp, 17.
North Carolina: Chapanoke, 1; Currituck, 4; Moran, 1; Raleigh, 53.
South Carolina: Georgetown, 1.
Georgia: Riceboro (Le Conte Plantation), 8.
Florida: Enterprise, 1;[1] Gainesville, 4;[1] Kissimmee, 3; Sawgrass Island, Polk County, 1; Tarpon Springs, 1;[2] Willow Oak, Pasco County, 1.[2]

REITHRODONTOMYS HUMULIS IMPIGER Bangs.

SMALL-EARED HARVEST MOUSE.

Reithrodontomys lecontii impiger Bangs, Proc. Biol. Soc. Wash., XII, 1898, p. 167.

Type locality.—White Sulphur Springs, W. Va.

Distribution.—Northern Virginia and mountains of West Virginia.

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[1] Collection Field Mus. Nat. Hist.

[2] Collection Acad. Nat. Sci. Phila.

Characters.—Closely similar in size and color to *humulis;* ears decidedly smaller.

Color.—Not appreciably different from that of *humulis.*

Skull.—Closely similar to that of *humulis.*

Measurements.—Average of 9 adults from type locality: Total length, 116 (114–122); tail vertebræ, 53 (50–57); hind foot, 15.7 (15–16.5); ear from notch, 8.7 (8–9). Skull: (See table, p. 81).

Remarks.—This subspecies is a rather poorly marked race of *humulis* occupying the northern end of the range of the species. In the series from the type locality—White Sulphur Springs, W. Va.—I have been unable to see any color differences to distinguish it from *humulis* from the coast of the Carolinas. Three specimens from the vicinity of Washington, D. C., however, are considerably paler than the series of topotypes, with which they agree in having very small ears. These may represent an undescribed race, but it seems best not to name it until more material can be secured.

Specimens examined.—Total number, 12, from the following localities:

West Virginia: White Sulphur Springs, 9.
Virginia: Alexandria, 1; Falls Church, 1; Fort Myer, 1.

REITHRODONTOMYS HUMULIS MERRIAMI Allen.

MERRIAM HARVEST MOUSE.

(Pl. I, fig. 2; Pl. IV, fig. 2; Pl. VII, fig. 8.)

Reithrodontomys merriami Allen, Bull. Am. Mus. Nat. Hist., VII, 1895, p. 119.

Type locality.—Austin Bayou, near Alvin, Tex.

Distribution.—Coast region of east Texas and southern Louisiana north to northeastern Kentucky and West Virginia; east to Alabama; limits of range imperfectly known.

Characters.—Similar to *humulis*, but upperparts blacker and grayer (less brownish); ears smaller and blacker.

Color.—*Adults:* Upperparts mixed blackish and light pinkish cinnamon, the black prevailing and forming usually a well-defined stripe in middle of back. Specimens in full, unworn pelage show an indistinct lateral stripe of light pinkish cinnamon. Ears blackish brown; tail fuscous above, grayish white below; underparts grayish, sometimes with a distinct wash of light pinkish cinnamon. Some specimens in worn pelage have a broad median dorsal band of black and scarcely any cinnamon on the sides. *Young:* Upperparts fuscous-black, practically without cinnamon hairs.

Skull.—Practically identical in size and proportions with that of *humulis*, but rostrum slightly heavier.

Measurements.—Average of 7 adults from type locality: Total length, 113 (107–128); tail vertebræ, 54 (51–60); hind foot, 16 (15.5–17). Skull (see table, p. 81).

Remarks.—This subspecies is a slightly differentiated race of *humulis*, with which it is connected by a complete series of intergrades. Indeed, occasional specimens of *humulis* from localities within the range of the typical race are difficult to distinguish from *merriami*. The differences are perhaps most evident on comparing individuals of the two forms in worn pelage, *merriami* being in that condition decidedly sooty, while *humulis* is a warm brown. Three specimens from Lexington, Ky., seem referable to this subspecies, but one from Ceredo, in the extreme western corner of West Virginia, is intermediate in color between *merriami* and *humulis*.

Specimens examined.—Total number, 37, from the following localities:

Texas: Austin Bayou near Alvin, 8; Richmond, 2.
Louisiana: Hackley, 1; Lafayette, 3; Mermenton, 3.[1]
Alabama: Barachias, 5; Carlton, 1; Dean, 1; Jackson, 2; York, 7.
Kentucky: Lexington, 3.
West Virginia: Ceredo, 1.

REITHRODONTOMYS ALBESCENS ALBESCENS Cary.

Pallid Harvest Mouse.

(Pl. I, fig. 4; Pl. IV, fig. 4.)

Reithrodontomys albescens Cary, Proc. Biol. Soc. Wash., XVI, 1903, p. 53.
Reithrodontomys montanus albescens Cary, N. Am. Fauna No. 33, 1911, p. 110.

Type locality.—Eighteen miles northwest of Kennedy, Nebr.

Distribution.—Sand-hill region of Nebraska and western South Dakota; west to Loveland, Colo.

Characters.—Similar to *R. montanus*, but paler, with a more distinct dorsal stripe; ears smaller; skull shorter and broader.

Color.—*Unworn winter pelage* (November): Upperparts mixed blackish and light buff, darkest on the median line and shading to pure buff on the sides; ears buffy, usually with two rather large brownish or blackish patches; tail sharply bicolor, dark hair-brown above, white below; feet soiled whitish; underparts pure white. *Worn summer pelage* (October): Upperparts mixed ochraceous-buff and blackish, the buff prevailing, shading to light ochraceous-buff on sides. A gray phase occurs in which the upperparts are mixed blackish and pale mouse-gray, with very slight admixture of buff.

Skull.—Shorter and relatively broader than that of *montanus*; rostrum short and heavy; zygomata heavy and widely expanded.

Measurements.—Average of 6 adults from Nebraska: Total length, 125 (121-129); tail vertebræ, 53.4 (50–56); hind foot, 16.7 (16.5–17). Skull (see table, p. 81).

Remarks.—This handsome mouse is the palest member of the genus. According to Cary it occurs only in sand-hills or on sandy land. At

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[1] Collection Field Mus. Nat. Hist.

Kennedy and Neligh, Nebr., it has been taken in the same weed patches with *R. megalotis dychei*. It may be distinguished from the latter by its smaller size, paler and less ochraceous coloration, and small ears with distinct black spots.

Although closely resembling *montanus* in color, it differs considerably from it in cranial characters, and no evidence of intergradation between the two species has been obtained. In southern Nebraska it grades into the subspecies *griseus*.

Specimens examined.—Total number, 25, from the following localities:

Nebraska: Kennedy, 1; 18 miles northwest of Kennedy, 4; Neligh, 8; Niobrara, 1; Niobrara River, 10 miles south of Cody, 2; Verdigris, 4.
South Dakota: Belle Fourche River (15 miles from mouth), 1.
Colorado: Loveland, 4.[1]

REITHRODONTOMYS ALBESCENS GRISEUS Bailey.

LITTLE GRAY HARVEST MOUSE.

(Pl. I, fig. 3; Pl. IV, fig. 3.)

Reithrodontomys dychei Allen, Bull. Am. Mus. Nat. Hist., VIII, 1896, p. 67 (not of VII, 1895, p. 120).
Reithrodontomys griseus Bailey, N. Am. Fauna No. 25, 1905, p. 106.

Type locality.—San Antonio, Tex.

Distribution.—Southern Nebraska, Kansas, Oklahoma, central and western Texas, and eastern New Mexico. Limits of range imperfectly known.

Characters.—Similar to *albescens* but colors darker and skull narrower; much paler and grayer than *merriami*.

Color.—Upper parts mixed black and light ochraceous-buff, the black predominating and usually forming an indistinct stripe along the median line; lateral line of buff very faintly indicated; buff on sides of head darker than in *montanus;* ears same color as back, usually with a large blackish patch on exterior surface; tail sharply bicolor, hair-brown above, grayish white below.

Skull.—Similar to that of *albescens*, but zygomata weaker and less widely expanded and rostrum narrower. Compared with *merriami:* Braincase less elongated; rostrum slenderer; zygomata more widely expanded posteriorly; interpterygoid fossa averaging narrower; bullae less elongated. Compared with *montanus:* Braincase shorter and relatively broader, with shorter rostrum; zygomata more contracted anteriorly.

Measurements.—Average of 9 specimens (mostly immature) from type locality: Total length, 115 (107–120); tail vertebræ, 54 (48–61); hind foot, 14.6 (14–16).[2] Average of 2 adults from Clyde and San

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[1] Collection of G. S. Miller, jr.

[2] The total length is probably less than in adult specimens and the foot measurements are apparently smaller in some cases than they should be.

Angelo, Tex.: 142; 60; 15. Average of 8 (subadult) from Alva, Okla.: 117; 51.5; 16. Skull: (See table, p. 81).

Remarks.—Although clearly belonging in the same group with *R. humulis merriami*, this form appears not to intergrade with it. In both skin and skull characters it agrees closely with *albescens* and differs widely from *merriami*, its nearest relative geographically. Specimens from Kansas and Oklahoma and one from Santa Rosa, N. Mex., can not be distinguished from typical examples.

Specimens examined.—Total number, 82, from the following localities:

Nebraska: London, 2.
Kansas: Onaga, 18; Pendennis, 5; Trego County, 10.
Oklahoma: Alva, 12.[1]
Texas: Clyde, 1; Gainesville, 1; Mason, 9; San Angelo, 1; San Antonio, 22.
New Mexico: Santa Rosa, 1.

REITHRODONTOMYS MEGALOTIS GROUP.

REITHRODONTOMYS MONTANUS (Baird).

SAN LUIS VALLEY HARVEST MOUSE.

(Pl. I, fig. 5; Pl. IV, fig. 5.)

Reithrodon montanus Baird, Proc. Acad. Nat. Sci. Phila., VII, 1855, p. 335; Mamm. N. Am., 1857, p. 449.
Ochetodon montanus Coues, Proc. Acad. Nat. Sci. Phila., 1874, p. 186.
Reithrodontomys montanus Allen, Bull. Am. Mus. Nat. Hist., V, 1893, p. 80; VII, 1895, p. 123; Cary, N. Am. Fauna No. 33, 1911, p. 108.

Type locality.—"Rocky Mountains, latitude 38°" [upper end San Luis Valley, Colo., near San Luis Lakes].

Distribution.—San Luis Valley, Colo.

Characters.—Size medium (smaller than *R. m. megalotis*, larger than *R. a. griseus*); ears small; color slightly paler and less ochraceous than in *megalotis;* skull similar to that of *megalotis* but smaller and narrower. Compared with *R. a. albescens* and *R. a. griseus:* No distinct blackish dorsal stripe; skull relatively longer and narrower; tail slightly longer.

Color.—*Fresh winter pelage* (October and November): Light buff, clearest on sides and face, much mixed with blackish on dorsal surface; black hairs most pronounced on hinder back; no distinct median line of black; ears dark hair-brown, often clothed on inner surface with ochraceous-buff hairs (a little darker than body hairs), rarely with a distinct blackish area on lower outer margin; tail distinctly bicolor, dark hair-brown above, white beneath; feet and underparts white. Compared with *megalotis*, the general tone is paler and less intensely ochraceous; the sides light buff instead of ochraceous-buff.

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[1] Collection Field Mus. Nat. Hist.

Skull.—Similar in shape to that of *R. m. megalotis*, but smaller and braincase relatively narrower; zygomata (in adults) with sides parallel. Compared with *R. a. griseus:* Longer and relatively narrower, with longer rostrum.

Measurements.—Average of 10 specimens (including adults and subadults) from Medano Ranch, near Mosca, Colo.: Total length, 126 (118–139); tail vertebræ, 58 (51–64); hind foot, 17 (16–17); ear from notch, 11.2 (11–12). Skull: (See table, p. 81).

Remarks.—This species, the second member of the genus to be recognized, was described by Baird in 1855 from a single specimen, and until within the last few years has remained practically unknown. Efforts were made by the Biological Survey field party in 1904 to secure specimens from the San Luis Valley and a single immature individual was caught at Del Norte by Vernon Bailey. In the autumn of 1907, Merritt Cary trapped for about 10 days at Medano Ranch, 15 miles northeast of Mosca, and succeeded in securing a series of 20 specimens, including several adults, which for the first time made possible accurate comparison and characterization of the species. Most of the specimens taken by Cary were caught in a grassy weed-patch on a broad sand-ridge extending through the meadows and perhaps 6 feet above their level. None was taken in wet situations.

Dr. J. A. Allen has determined the approximate type locality of this species from a careful study of the records of Capt. Beckwith's expedition, on which the type was secured.[1] The type specimen (No. 13 of the expedition) was collected in August, 1853, in the upper end of the San Luis Valley, at some point between Fort Massachusetts and Sahwatch Creek. The route of the expedition was northward along the east side of the valley to a point a little north of 38° latitude, and thence westward across the valley not far from the present town of Saguache.[2] The second camp of the party, on the night of August 24, was on a small stream "nearly opposite to Roubideau's or Mosca Pass," about 21 miles from Fort Massachusetts. The specimens collected by Cary in 1907 were taken along the very creek on which the Beckwith party camped, now called Medano Creek. The type may have been taken on this creek or at one of the other camping places a few miles farther north.

Even with a series of 20 topotypes, the relationships of this species are not entirely clear. This uncertainty is due in part to the fact that the topotype series includes only two adults, one of which has the skull broken, and in part to the failure to find in the series a single skull that agrees with that of the type. The latter, an adult with moderately worn teeth, is decidedly smaller and has a much shorter rostrum than the two adults taken by Cary at Medano Ranch, thus closely agreeing with specimens of *R. a. griseus* from Texas. The rostrum of this specimen is deflected markedly to the right, indicating an injury during life, which may account for its small size and peculiar characters. The original description of the color accords perfectly with the series now in hand, so that there seems no alternative but to consider the type skull aberrant, and to continue to use the name for the form represented by the modern series.

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[1] See Bull. Am. Mus. Nat. Hist., VII, 1895, pp. 124–125.

[2] See Expl. & Surv. Pac. R. R., II, pp. 41–45, and map accompanying Vol. XI.

The species, although combining in a remarkable degree the characters of the *megalotis* and *albescens* groups, seems not to be directly connected with either of them. It is perhaps best placed in the *megalotis* group, but seems not to intergrade with any member of it.[1] Though but little smaller than *R. m. megalotis*, it is markedly smaller than *aztecus*—the form ranging through northern New Mexico, nearest to the home of *montanus*. It may be distinguished from both *megalotis* and *aztecus* by smaller size, particularly of the ears and tail, and by paler and less ochraceous coloration. Externally it much resembles *R. a. albescens* but is somewhat darker and has larger ears and feet. The nearest approach geographically of *R. albescens griseus* to the range of *montanus* is at Santa Rosa, N. Mex., and the single specimen taken there shows no departure from typical *griseus*.

Specimens examined.—Total number, 21, from the following localities:

Colorado: Del Norte, 1; Medano Ranch (15 miles northeast of Mosca), 20.

REITHRODONTOMYS MEGALOTIS MEGALOTIS (Baird).

DESERT HARVEST MOUSE.

(Pl. I, fig. 6; Pl. IV, fig. 6; Pl. VII, figs. 1, 7.)

Reithrodon megalotis Baird, Mamm. N. Am., 1857, p. 451.
Reithrodontomys megalotis Allen, Bull. Am. Mus. Nat. Hist., V, 1893, p. 79; VII, 1895, p. 125.
Reithrodontomys megalotis deserti Allen, Bull. Am. Mus. Nat. Hist., VII, 1895, p. 127 (Oasis Valley, Nev.).
Reithrodontomys megalotis sestinensis Allen, Bull. Am. Mus. Nat. Hist., XIX, 1903, p. 602 (Rio Sestin, northwestern Durango).

Type locality.—Between Janos, Chihuahua, and San Luis Springs, N. Mex.

Distribution.—From northern Nevada and southern Idaho south to Zacatecas, Mexico; occupying the greater part of Nevada, Arizona, and Utah (except eastern part); southern New Mexico; western Texas (west of Pecos River); desert regions of southern and northeastern California, northeastern Lower California, and northern Sonora; and northern portion of Mexican table-land.

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[1] Cary's assignment of this species to the *albescens* group (N. Am. Fauna No. 33, 1911, p. 108) was on the authority of the present writer, who, after more detailed study, has reached the conclusions set forth above.

Characters.—Size medium (larger than *R. montanus* and smaller than *R. f. fulvescens*); general tone brownish buff above and white below; ears usually without dark markings.

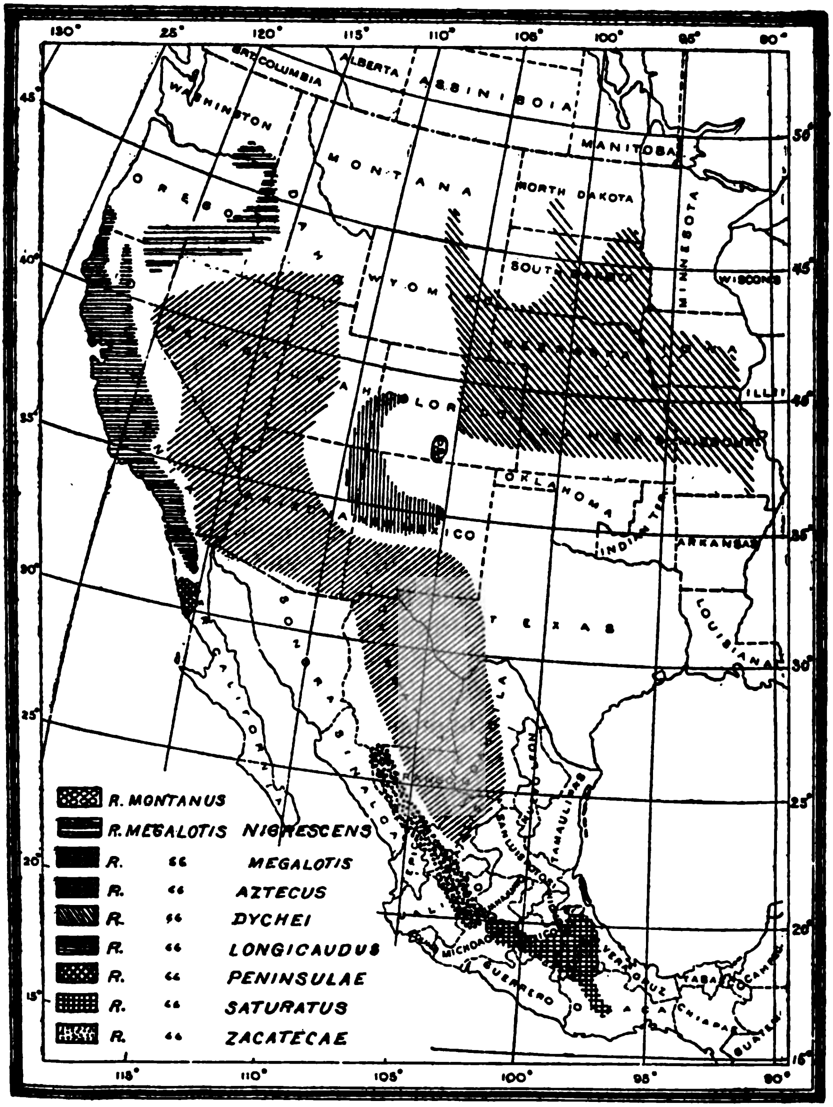

FIG. 2.—Distribution of *Reithrodontomys montanus*, *R. megalotis*, and subspecies.

Color.—*Unworn winter pelage:* Upperparts mixed blackish brown and light ochraceous-buff, darkest in middle of back, shading to nearly pure buff on sides; feet and underparts white; tail hair-brown above, whitish below; ears drab, usually with a tuft of ochraceous-buff hairs at base. *Unworn summer pelage:* Similar to the fresh winter pelage, but colors less strongly contrasted and black variations of upperparts much reduced. *Worn spring and summer pelage:* General tone browner and colors less contrasted than in the winter pelage, the buff on sides less pronounced and often lacking.

Skull.—Larger than that of *montanus*, with broader, flatter braincase. Compared with *fulvescens* and *tenuis:* Slightly smaller, with longer palatal foramina and narrower interpterygoid fossa.

Measurements.—Average of 6 adults from type region (Casas Grandes, Chihuahua; Mexican boundary, 50 to 100 miles west of El Paso; and Organ Mountains, N. Mex.): Total length, 140 (128–145); tail vertebræ, 71 (65–77); hind foot, 17.6 (17–18.5); ear from notch, 12.5 (12–13.2). Average of 12 adults from Lone Pine, Cal.: 139; 70; 17.5; of 10 adults from Oasis Valley, Nev. (measured to end of tail hairs): 139; 72; 18.4. Skull: (See table, p. 81).

Remarks.—This subspecies has the widest range of any of the forms of *megalotis* and is subject to considerable individual variation, both in color and in size of skull. It intergrades with *aztecus* in central New Mexico, with *longicaudus* in California, with *nigrescens* in southern Idaho, and with *cinereus* in central Mexico. The present writer is in accord with Dr. J. A. Allen, who revised the group in 1895, in his failure to find any constant color differences between the series from the deserts of Nevada and California and that from the type region (southern New Mexico and northern Chihuahua), individuals in comparable pelage from the two regions being practically indistinguishable. Specimens from the Death Valley region of southern California and Nevada have slightly larger skulls than those of the typical form from Chihuahua and southern New Mexico but smaller than those of *aztecus*. These have been separated as a subspecies, "*deserti*" by Dr. Allen on the basis of an alleged difference in the relative length of body and tail. A careful comparison of measurements of adult specimens from the two regions, however, fails to show any appreciable differences in proportion. The apparent differences shown in Dr. Allen's published measurements probably are due in part to differences in methods of measurement and in part to the inclusion of a greater number of immature examples in the series from New Mexico and Utah. The cranial differences are considered too slight and inconstant to warrant recognition of the form by name.

A large series from the Colorado River, Sonora, at Monument No. 204, Mexican boundary, are practically typical *megalotis*. Two individuals from Volcano Lake, head of Hardy River, Lower California, are very small, but no smaller than an individual in the series from Casas Grandes, Chihuahua, quite close to the type locality.

A large series from various places in northwestern Nevada and a small series from Salt Lake Valley, Utah, are fairly typical *megalotis*, having slightly smaller skulls than the Death Valley series and thus showing no approach to *aztecus*.

Intergradation with *longicaudus* is perfectly shown by a large series from the Mojave Desert in southern California. In color these specimens are intermediate between the two races, but rather nearer to *megalotis*, while in skull characters they most resemble *longicaudus*. Some individuals in the series much resemble *nigrescens*, but are generally more suffused with buff. A series from the south fork of Kern River, Cal., are nearly typical *megalotis* but slightly browner.

In New Mexico the typical form occurs only in the extreme southern part, near the Mexican boundary, a gradual increase in size of skull being observed as we proceed northward toward the range of *aztecus*. Southward over the Mexican table-land there is no perceptible change in color as far as Zacatecas. Specimens from northwestern Durango, described by Allen under the name "*sestinensis*," do not differ appreciably from the typical form.

Specimens examined.—Total number, 415, from the following localities:

Idaho: American Falls, 2; Swan Lake, 1.

California: Amedee, 2; Argus Mountains, 1; Barstow, 12; Bishop Creek, 1; Cartago, Owens Lake, 10; Colorado River (opposite Parker, Ariz.), 4; Emigrant Spring, 1; Fort Yuma, 1; Furnace Creek, Death Valley, 5; Grapevine Spring, 4; Keeler, 4; Lone Pine, 30; Long Valley (Lassen County), 4; Mojave, 3;[1] Olanche, Owens Lake, 22; Owens Valley, 8; Onyx, south fork of Kern River, 19;[1] Panamint Mountains, 7; Panamint Valley, 2; Pilot Knob, 8; Resting Spring, 3; Saratoga Spring, 3; Shepherd Canon, Argus Mountains, 1; Tehachapi, 20;[1] Twelve Mile Spring, Inyo County, 1; Victorville, 1.[1, 2]

Nevada: Ash Meadows, 30; Carson Sink, 1; Fallon, 5; Gardnerville, 1; Grapevine Mountains, 2; Oasis Valley, 16; Pahranagat Valley, 4; Pahrump Valley, 11; Panaca, 1; Pine Forest Mountains, 7;[3] Quinn River Crossing, 20;[3] St. Thomas, 1; Smoky Creek, 1; Vegas Valley, 5; Verdi, 3; Virgin Valley, 1.[3]

Arizona: Colorado River at Monument No. 204, Mexican boundary, 27; Fairbank, 2; Grand Canyon (Indian Gardens), 2; Lee's ferry, 1; Parker, 5; St. Johns, 2; Winslow, 17; Zuni River, 1.

New Mexico: Animas Valley, 1; Deming, 3; Dry Creek, Socorro County, 3; Fairview, 1; Gallo Canyon, 35 miles southeast of Corona, 1; Gila, Grant County, 1; Glenwood, 1; Jicarilla Mountains, 1; Kingston, 2; Las Cruces, 3; Las Palomas, 5; Mesa Jumanes, 2; Monument No. 15, Mexican boundary, 1; Monument No. 40, Mexican boundary, 3; Organ Mountains, 3; Pleasanton, 1; Redrock, Grant County, 1; Roswell, 1; San Andreas Mountains, 2; San Mateo Mountains, Socorro County, 2; Silver City, 3; Tularosa, 5.

Texas: Alpine, 1; 25 miles west of Fort Stockton, 1; Franklin Mountains, 1; Guadalupe Mountains, 1; Pecos City, 1.

Lower California: Gardners Lagoon, 1; Seven Wells, 2.

Sonora: Cienega Well, 30 miles south of Monument No. 204, Mexican boundary, 1.

Chihuahua: Casas Grandes, 4; Chihuahua, 2.

Coahuila: Saltillo, 1; Sierra Guadalupe, 1.

Durango: Rio Sestin, 4.[4]

Zacatecas: Zacatecas, 2.

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[1] Approaching *longicaudus*.

[2] Received from Jos. Grinnell.

[3] Collection Mus. Vert. Zool., Univ. of Cal.

[4] Collection Amer. Mus. Nat. Hist.

REITHRODONTOMYS MEGALOTIS AZTECUS Allen.

AZTEC HARVEST MOUSE.

Reithrodontomys aztecus Allen, Bull. Am. Mus. Nat. Hist., V, 1893, p. 79.

Type locality.—La Plata, N. Mex.

Distribution.—Northern New Mexico, northeastern Arizona, southeastern Utah, and western Colorado, north to Grand Junction and Rifle.

Characters.—Similar to *megalotis* but with larger ears and skull.

Color.—Not appreciably different from that of *megalotis;* ears sometimes with irregular dusky blotches.

Skull.—Decidedly larger than that of *megalotis.*

Measurements.—Average of 7 adults from La Plata and Aztec, N. Mex., and Noland Ranch, Utah: Total length, 144 (133–155); tail vertebræ, 68 (62–73); hind foot, 18 (17–19); ear from notch, 13.8 (12–15.5). Skull (see table, p. 81).

Remarks.—This subspecies does not differ from *megalotis* in color, but its skull is so much larger that it seems desirable to recognize the race. The ears average larger, also, in the series from the type region. Dr. Allen provided the form with a provisional name many years ago, but later placed it in synonymy.

This race is connected with *megalotis* by a complete series of intergrades from New Mexico and Arizona. The specimens from Datil and Manzano Mountains are too young to be satisfactorily identified, but are provisionally referred to *aztecus.*

Specimens examined.—Total number, 143, from the following localities:

New Mexico: Aztec, 39; Espanola, 8; Farmington, 4; Fruitland, 6; Gallup, 1; Guadalupita, 1; La Plata, 32; Las Vegas, 2; Manzano Mountains, 1; Rinconada, 1; Rio Puerco, 4; Wingate, 2.

Arizona: Canyon de Chelly, 1.

Utah: Bluff City, San Juan River, 4; Noland Ranch, San Juan River, 5.

Colorado: Arboles, 1; Ashbaugh's Ranch, Montezuma County, 2; Cortez, 1; Grand Junction, 26; Rifle, 2.

REITHRODONTOMYS MEGALOTIS DYCHEI Allen.

PRAIRIE HARVEST MOUSE.

(Pl. I, fig. 7; Pl. IV, fig. 7.)

Reithrodontomys dychei Allen, Bull. Am. Mus. Nat. Hist., VII, 1895, p. 120.

Reithrodontomys dychei nebrascensis Allen, Bull. Am. Mus. Nat. Hist., VII, 1895, p. 122 (Kennedy, Nebr.).

Reithrodontomys griseus Ruthven & Wood, Proc. Iowa Acad. Sci., XIX, 1912, p. 204 (not of Bailey).[1]

Type locality.—Lawrence, Kans.

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[1] Misidentification of specimen by the present writer.

Distribution.—Greater part of Kansas, Nebraska, Iowa, Missouri, and South Dakota; southern North Dakota; southeastern Montana; eastern Colorado and eastern Wyoming.

Characters.—Similar to *megalotis,* but black of upperparts more extensive and ochraceous shades more intense; ears slightly smaller; tail shorter.

Color.—*Full winter pelage* (topotypes): Upperparts mixed black and light ochraceous-buff; in some specimens the median dorsal area is noticeably darker, in others the color is nearly uniform over the whole back; sides clear buff, the lateral line sometimes, though not always, well-marked; ears hair-brown externally, thinly clothed with buffy hairs on inner surface, and with a tuft of ochraceous-buff hairs at anterior base; feet and underparts white; tail sharply bicolor, dark hair-brown above, white beneath.

Skull.—About same size as that of *megalotis* (smaller than that of *aztecus*); rostrum shorter and broader.

Measurements.[1]—Type: Total length, 133; tail vertebræ, 52; hind foot, 15.5. Average of 6 nearly adult specimens from eastern Nebraska (Neligh and Verdigris): Total length, 135 (130–142); tail vertebræ, 61 (57–65); hind foot, 17.5 (16.5–18); ear from notch, 10. 5 (10.3–11.1). Average of 8 adults from Kennedy, Nebr.: 133; 63; 17.5; 10.8. Skull: (See table, p. 81).

Remarks.—This form clearly belongs in the *megalotis* group and apparently intergrades with *aztecus,* as indicated by specimens from central Colorado (Loveland, Greeley, and Canon City). These average slightly paler and grayer than the typical form and their skulls are intermediate in size, with somewhat longer rostri than in typical *dychei.*

The series from Kennedy, Nebr., on which Dr. Allen based the subspecies "*nebrascensis*" seem to be indistinguishable from specimens of typical *dychei* in comparable pelage. At many localities in Nebraska and Kansas *R. albescens griseus* occurs with the present species, and although occasional specimens are hard to distinguish by color alone, yet in size and cranial characters the species are distinct. Dr. Allen confused the two in his original description of *dychei,* the series listed from Onaga, Kans., and London, Nebr., being referable to *griseus.* The latter race may be distinguished from *dychei* by its smaller size, shorter tail, and smaller skull with short rostrum and short palatal foramina. In coloration *dychei* is more intensely ochraceous than *griseus* and often not conspicuously darkened on the dorsal area; *griseus* is distinctly grayer and the ochraceous-buff of the sides is paler and less extensive.

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[1] The great variation in the measurements of this species given by Dr. Allen in the original description indicates that probably many of the specimens were immature and the average therefore too small.

Specimens examined.—Total number, 153, from the following localities:

North Dakota: Ellendale, 2; Fort Clark, 4; Hankinson, 4; Ludden, 2; Oakes, 1.
South Dakota: Clay County, 2.
Montana: Billings, 5; Fort Custer, 4.
Wyoming: Arvada, 4; Casper, 1; Meadow, 1; Pole Creek, Laramie County, 1; Splitrock, 3; Sun, 3.
Colorado: Boulder, 1; Canon City, 5; Denver, 2; Golden, 2; Greeley, 1; Loveland, 14; Valmont, 1.
Kansas: Cloud County, 2;[1] Lawrence, 9;[2] Neosho Falls, 1; Onaga, 18; Pendennis, 5.
Nebraska: Alliance, 2; Beemer, 1; Callaway, 3; Cherry County, 1; 10 miles south of Cody, 1; Columbus, 3; Ewing, 1; Glen, Sioux County, 1; Haigler, 2;[3] Kearney, 2; Kennedy, 12; 18 miles northwest of Kennedy, 5; Neligh, 9; Norfolk, 1; Two Mile Lake, Cherry County, 1; Valentine, 2; Verdigris, 2.
Iowa: Atlantic, 2; Hillsboro, 2; Palo Alto County, 1.[4]
Missouri: St. Louis, 1; Thayer, 2.

REITHRODONTOMYS MEGALOTIS NIGRESCENS subsp. nov.

DUSKY HARVEST MOUSE.

Type from Payette, Idaho. No. 201616, U. S. Nat. Mus., Biological Survey Collection, ♂ adult, June 9, 1913; L. E. Wyman. Original No. 98.

Distribution.—Eastern Oregon and western Idaho; north to Prescott, Wash., south to Bieber, Cal.

Characters.—Similar to *megalotis*, but upperparts more blackish and less buffy; grayer and less ochraceous than *longicaudus*.

Color.— *Winter pelage:* Upperparts mixed blackish and pale ochraceous-buff, the black predominating on dorsal area; lateral line of buff only faintly indicated; ears hair-brown, clothed with ochraceous hairs; tail blackish brown above, white below; feet and underparts white. *Summer pelage* (July): General tone of upperparts more brownish and less blackish than in winter pelage.

Skull.—Closely similar to that of *megalotis*, but with slightly longer nasals.

Measurements.—Average of 7 adults from Idaho: Total length, 144 (140–153); tail vertebræ, 68 (63–75); hind foot, 17 (16–18). Skull: (See table, p. 81).

Remarks.—This race occupies the extreme northwestern part of the range of the species, chiefly in a region of old lava beds where the soil is richer and vegetation more abundant than in the more arid deserts to the southward. It is most nearly related to *megalotis*, but probably intergrades also with *longicaudus*.

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[1] Collection Kansas Univ. Mus.
[2] Collection Am. Mus. Nat. Hist.
[3] Collection Univ. of Nebraska.
[4] Collection Univ. of Michigan.

Specimens examined.—Total number, 36, from the following localities:

Washington: Prescott, 7.
Oregon: Narrows, Malheur County, 11; Vale, 1.
California: Bieber, 1; Brownell, 4.
Idaho: Nampa, 5; Payette, 5; Weiser, 2.

REITHRODONTOMYS MEGALOTIS LONGICAUDUS (Baird).

California Harvest Mouse.

Reithrodon longicauda Baird, Mamm. N. Am., 1857, p. 451.
Ochetodon longicauda Coues, Proc. Acad. Nat. Sci. Phila., 1874, p. 186; Mon. N. Am. Rodentia, 1877, p. 126.
Reithrodontomys pallidus Rhoads, Am. Nat., XXVII, 1893, p. 835 (Santa Ysabel, Cal.).
Reithrodontomys longicauda Allen, Bull. Am. Mus. Nat. Hist., VII, 1895, p. 129.
Reithrodontomys klamathensis Merriam, N. Am. Fauna No. 16, 1899, p. 93 (Shasta Valley, Cal.).
Reithrodontomys megalotis longicauda Grinnell, Proc. Cal. Acad. Sci., Ser. 4, III, 1913, p. 303.

Type locality.—Petaluma, Cal.

Distribution.—Greater part of western California, east to the foothills of the Sierra Nevada, San Bernardino, and San Jacinto Ranges; north to Grants Pass, Oreg., and south into northwestern Lower California to about latitude 32°.

Characters.—Slightly smaller than *megalotis;* colors darker and more intense.

Color.—*Fresh winter pelage:* Upperparts mixed blackish and ochraceous-buff, the black predominating on dorsal area, shading to nearly pure ochraceous-buff on sides; lateral line of buff often well defined; ears same color as back, clothed with scattering ochraceous hairs; feet grayish white; tail sharply bicolor, hair-brown or fuscous above, grayish white below; underparts grayish white, usually with a tinge and often with a strong wash of ochraceous-buff. *Fresh summer pelage:* Similar to the winter pelage, but decidedly paler and lacking most of the black on the dorsal area.

Skull.—Similar to that of *megalotis*, but smaller.

Measurements.—Adult topotype: Total length, 152; tail vertebræ, 75; hind foot, 17.5. Average of 13 specimens (mostly young adults) from vicinity of San Francisco Bay: 139 (130–146); 73 (68–79); 17 (16–18). Skull: (See table, p. 81).

Remarks.—This form has a wide range on the Pacific coast and intergrades with *megalotis* at various points along the edge of the deserts. Intermediate specimens have been examined from Barstow, Mojave, Tehachapi, Santa Paula, Kern River, Bieber, etc. The form from Shasta Valley described under the name "*klamathensis*" is likewise intermediate between *longicaudus* and *megalotis*, specimens from there agreeing exactly in color with summer specimens of *longicaudus* from

Petaluma, while their skulls can be matched very closely in the series of *megalotis*. The type of "*klamathensis*" is a very old individual and has a skull as large as that of *R. m. aztecus*. Skulls of topotypes, however, do not differ appreciably from skulls of *megalotis* from the Death Valley region. *Reithrodontomys* "*pallidus*" of Rhoads is a pure synonym of *longicaudus*, neither the type nor topotypes being distinguishable from typical specimens of this race. Color variation in this subspecies is considerable and the winter and summer pelages are strikingly different.

Specimens examined.—Total number, 555, from the following localities:

Oregon: Grants Pass, 1.[1]

California: Adobe Station, 1;[2] Alton Junction, Humboldt County, 3; Aptos, 15; Armona, 1; Arroyo Seco, 10 miles south of Paraiso Springs, 4; Arroyo Seco Canyon, near Pasadena, 1;[3] Ballena, San Diego County, 3; Banta, 8; Bear Valley, head of Carmel River, 2; Bear Valley, San Benito County, 1; Bergman, Riverside County, 1; Berkeley, 31; Boulder Creek, 2; Briceland, 2; Burbank, 4; Calabasas, 1; Cameron's Ranch, San Diego County, 1; Campo, San Diego County, 1; Carlsbad, San Diego County, 3; Carpenteria, 2; Chico, 6; Chinese Camp, 1; Church Ranch, 5 miles north of Tassajara Springs, 2; Dulzura, 1; El Nido, Jamul Creek, 9; Elsinore, 2; Eshom Valley, Tulare County, 1; Fairfield, 3; Fort Bragg, 1; (old) Fort Tejon, 1; Freestone, 2; Fremont Peak, Gabilan Range, 3; Fresno, 3; Fresno Flat, 4; Gaviota Pass, 5; Gilroy, 2; Glen Ellen, 10; Hueneme, 3; Humboldt Bay, 3; Jackson, 1; Jacumba, 8; Jamesburg, 5; Jolon, 4; King City, 1; Lagunitas, 1; Las Virgines Creek, 2; Laytonville, 1; Lebec, 1; Leesville, 6; Lemoore, 2; Los Banos, 1; Los Olivos, 2; Lower Lake, 3; Lytle Creek, Los Angeles County, 2; Martinez, 1; Marysville, 6; Marysville Buttes, 12; Mendota, 2; Milpitas Ranch, south base Santa Lucia Peak, 3; Milquatay Valley, 1; Modesto, 1; Mono Flats, Santa Ynez River, 2; Montalvo, 3; Monterey, 16; Morro, 2;[2] Mountain Spring, San Diego County, 3; Mount George, 2; Mount St. Helena, 2; Nelson, Butte County, 2; Nicasio, 5; Novato, 3; Oakland, 1; Oceanside, 1; Orosi, 2; Pacheco Pass, Santa Clara County, 1; Pacific Grove, 3; Pacific Ocean, near Mexican boundary, 6; Palo Alto, 1; Paraiso Springs, 8;[2] Paso Robles, 5; Petaluma, 6;[1] Petrolia, 9; Pine Valley, Monterey County, 1; Point Reyes, 19; Porterville, 1; Posts, 5; Pozo, 3;[2] Radec, Riverside County, 2; Riverside, 5; Rockport, 5; Salinas, 4; San Bernardino, 13;[2] San Bernardino Mountains (altitude 5,200 feet), 6; San Diego, 6; San Emigdio Canyon, 7; San Fernando, 7; San Jacinto, 1; San Luis Obispo, 5;[2] San Marcos, 1; San Mateo, 15; San Pasqual Valley, 1; San Pedro, 1; San Simeon, 5; Santa Barbara, 2; Santa Maria, 3; Santa Monica, 4; Santa Paula, 17;[2] Santa Ynez Mission, 4; Santa Ysabel, 5; Santiago Springs, San Luis Obispo County, 1;[2] San Ygnacio Valley, San Diego County, 1; Shasta Valley, 7;[2] Soledad, 2;[2] Stanford University, 22; Strawberry Valley, San Jacinto Mountains, 3; Sur, 6; Sur River, 6; Tecate Valley, 3; Tecelote Canyon, 1; Tehama, 4; Tejon Canyon, 3; Temescal, 2; Three Rivers, 1; mouth Tia Juana River, 1; Tracy 10; Twin Oaks, 1; Ventura River, 2; Walnut Creek, 20; Warren's Ranch, Riverside County, 1; Westport, 2.

Lower California: El Rayo, Hanson Laguna Mountains, 1; La Huerta, Hanson Laguna Mountains, 1; Nachoguero Valley, 2; Rancho Viejo, 15 miles east of Alamos, 1; San Isidro Ranch, near monument No. 250, Mexican boundary, 5.

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[1] Collection Field Mus. Nat. Hist. [2] Approaching *megalotis*. [3] Collection of Joseph Grinnell.

REITHRODONTOMYS MEGALOTIS PENINSULÆ Elliot.

PENINSULA HARVEST MOUSE.

Rhithrodontomys peninsulæ Elliot, Pub. Field Columb. Mus., Zool. Ser., III, 1903, p. 164.

Type locality.—San Quintin, Lower California.

Distribution.—West coast of Lower California, between latitude 30° and 31°; southern limit of range not definitely known.

Characters.—Similar to *longicaudus*, but with larger ears and longer tail.

Color.—*Fresh pelage* (October to January): Similar to corresponding pelage of *longicaudus*, but averaging richer and redder, and less brownish on the back; underparts white with a tinge of ochraceous-buff. *Worn summer pelage:* Specimens not appreciably different from *longicaudus* in same pelage.

Skull.—Similar to those of *megalotis* and *longicaudus*.

Measurements.—Average of 11 specimens (adult and subadult) from type locality: Total length, 154 (140–170); tail vertebræ, 84 (78–91); hind foot, 17.4 (16–18). Skull: (See table, p. 81).

Remarks.—This form has a rather restricted range on the Pacific coast of Lower California. It is closely related to *longicaudus*, with which it intergrades in the vicinity of San Telmo.

Specimens examined.—Total number, 32, from the following localities:

Lower California: Pozo Luciano (northwest slope San Pedro Martir Mountains), 1; Rosario, 20;[1] San Quintin, 8; San Telmo, 1; Socorro, 2.

REITHRODONTOMYS MEGALOTIS CINEREUS Merriam.

ASHY HARVEST MOUSE.

Reithrodontomys saturatus cinereus Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 556.

Type locality.—Chalchicomula, Puebla, Mexico.

Distribution.—Southern portion of Mexican table-land in the States of Hidalgo, Puebla, and Tlaxcala.

Characters.—Slightly larger and darker than *megalotis* with much darker ears and tail; paler than *saturatus*.

Color.—Upperparts mixed black and light ochraceous-buff; darkest in the median line where the black sometimes appears as a broad band; sides light ochraceous-buff; underparts grayish white with a tinge of ochraceous-buff and sometimes with one or more small blotches of the same color, chiefly in the pectoral region; ears fuscous, with a large blackish patch on the inferior inner margin and another on the superior outer margin; tail, fuscous, darker than in *megalotis*.

Skull.—Practically the same as that of *saturatus*, possibly a little shorter.

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[1] Including 9 from Collection Mus. Comp. Zool.

Measurements.—Average of 5 adults from type locality: Total length, 148 (142–151); tail vertebræ, 74 (71–78); hind foot, 19 (18.5–19.5). Skull: (See table, p. 81).

Remarks.—This form is intermediate between *megalotis* and *saturatus*, being slightly larger externally than *megalotis*, with skull about the size of that of *saturatus*. One of the topotype series matches *megalotis* very closely in color, but the others are much darker; all have darker ears, tail, and underparts.

The range of *cinereus* is apparently not extensive and is nearly surrounded by that of *saturatus*, at least on the east, south, and west.

Specimens examined.—Total number, 11, from the following localities in Mexico:

Puebla: Chalchicomula, 5; Mount Orizaba, 1.
Tlaxcala: Apizaco, 2; Huamantla, 1.
Hidalgo: Real del Monte, 2.

REITHRODONTOMYS MEGALOTIS SATURATUS Allen & Chapman.

DUSKY HARVEST MOUSE.

(Pl. I, fig. 8; Pl. IV, fig. 8.)

Reithrodontomys saturatus Allen and Chapman, Bull. Am. Mus. Nat. Hist., IX, 1897, p. 201.

Type locality.—Las Vigas, Vera Cruz.

Distribution.—From Jalisco (Ocotlan), Hidalgo, and Vera Cruz south to Oaxaca; altitudinal range approximately from 6,000 to 10,000 feet.

Characters.—Larger and darker (blacker and more intensely ochraceous) than *cinereus*.

Color.—Upperparts mixed black and ochraceous-buff, the black predominating; sides with less black but without a distinct ochraceous line; underparts grayish white, often strongly suffused with ochraceous-buff; ears blackish, or fuscous with a large blackish patch on the inner posterior margin; tail sharply bicolor, fuscous-black above, whitish beneath; feet grayish white.

Skull.—Similar in proportions to that of *megalotis* but decidedly larger; zygomata parallel or slightly contracted anteriorly; closely similar to those of *tenuis* and *difficilis*, but averaging larger, with larger bullæ and longer palatal foramina.

Measurements.—Average of 7 adults from type locality: Total length, 162 (158–169); tail vertebræ, 87 (80–95); hind foot, 19 (18–19.5). Skull: (See table, p. 81).

Remarks.—This is the largest and darkest form in the *megalotis* group. It occupies the humid mountain slopes of southern Mexico, intergrading with *cinereus* along the edge of the table-land and with *zacatecæ* in Michoacan. Its range meets that of *R. fulvescens* *difficilis* in Vera Cruz, and the two may occur together in some localities. They are closely similar in general appearance, but *saturatus* may be distinguished by its blacker ears and back, whiter underparts, and larger skull. Specimens from Oaxaca City are redder than typical specimens, with less black on the dorsal area, but two from the mountains west of Oaxaca are typical.

Specimens examined.—Total number, 68, from the following localities in Mexico:

Vera Cruz: Huauchinango, 1; Las Vigas, 11; Mount Orizaba, 2;[1] Perote, 6; Xuchil, 7.[1]
Hidalgo: Tulancingo, 1.
Mexico: Salazar, 6; Toluca Valley, 2; Volcan Toluca, 1.
Morelos: Huitzilac, 3.
Michoacan: Nahuatzin, 9.
Jalisco: Ocotlan, 3.
Oaxaca: Mount Zempoaltepec, 4; mountains 15 miles west of Oaxaca, 2; mountains near Ozolotepec, 1; Oaxaca City, 6; Tamazulapam, 1; Tlapancingo, 2.

REITHRODONTOMYS MEGALOTIS ALTICOLUS Merriam.

CERRO SAN FELIPE HARVEST MOUSE.

(Pl. I, fig. 12; Pl. IV, fig. 12.)

Reithrodontomys megalotis alticolus Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 556.

Type locality.—Cerro San Felipe, Oaxaca, Mexico (altitude 10,000 feet).

Distribution.—Known only from vicinity of type locality.

Characters.—Similar to *saturatus;* tail shorter; skull with larger bullæ and more inflated braincase.

Color.—Upperparts mixed black and ochraceous-buff, darkest on the dorsal area; ears fuscous, with a blackish patch on lower inner margin; feet buffy white; ankles with a dusky streak; tail hair-brown above, grayish white beneath.

Skull.—Similar in size and proportions to that of *saturatus;* braincase more inflated (subglobular); bullæ larger and more inflated; nasals narrowed to a point posteriorly.

Measurements.—Type (♂ ad.): Total length, 153; tail vertebræ, 75; hind foot, 19. Average of two adults from La Parada, Oaxaca: 152; 78.5; 18.5. Skull: (See table, p. 81).

Remarks.—This subspecies is a slightly differentiated form, very closely related to *saturatus,* from which it differs chiefly in shorter tail and in slight cranial characters. It seems to be confined to the Cerro San Felipe and its environs. Specimens from La Parada, at the base of the mountain, are not quite typical.

Specimens examined.—Total number, 3, from the following localities in Mexico:

Oaxaca: Cerro San Felipe, 1; La Parada, 2.

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[1] Collection Field Mus. Nat. Hist.

REITHRODONTOMYS MEGALOTIS ARIZONENSIS Allen.

CHIRICAHUA HARVEST MOUSE.

Reithrodontomys arizonensis Allen, Bull. Am. Mus. Nat. Hist., VII, 1895, p. 134.

Type locality.—Rock Creek, Chiricahua Mountains, Ariz. (altitude about 8,000 feet).

Distribution.—Known only from the type locality.

Characters.—About the size of *megalotis;* tail averaging slightly longer; colors much darker and more ochraceous. Very similar to *longicaudus*, but a little redder on the head, ears blacker, and tail paler (hoary gray instead of brown).

Color.—Upperparts ochraceous-buff, heavily mixed with black; front and sides of face nearly pure buff; ears dark hair-brown, with darker patches on both inner and outer margins; feet white; ankles dusky; underparts white, with an ochraceous patch on the breast between the fore legs; tail mouse-gray above, grayish white below, clothed all around with scattered whitish hairs.

Skull.—Closely similar to that of *megalotis.*

Measurements.—Average of 4 adults from type locality: Total length, 149 (145–152); tail vertebræ, 78 (74–80); hind foot, 17 (16–18); ear, 13 (12.5–14). Skull: (See table, p. 81).

Remarks.—This subspecies, as noted by the original describer, bears a surprising resemblance to *R. megalotis longicaudus* of California, but the ranges of the two forms are separated by an extensive area occupied by *R. m. megalotis*, and the present form is probably more closely related to *R. m. zacatecæ* of the mountains of western Mexico, the range of which is known to extend north at least to southern Chihuahua. The latter differs from *arizonensis* chiefly in its more ochraceous underparts.

No intergrades between *arizonensis* and *megalotis* are known, but quite probably such will later be found. Likewise the present form is so close to *zacatecæ* that the two will probably be found to intergrade. Mr. W. W. Price, who collected the type series, thus describes its habitat:

> Five specimens of this species were trapped on Rock Creek, in the Chiricahua Mountains, July 7–8, at an elevation of about 8,000 feet. Two were in rocks and dry soil away from the bed of the creek, and the others were caught under logs and brush near the water.[1]

Specimens examined.—Four, from type locality.[2]

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[1] Allen, Bull. Am. Mus. Nat. Hist., VII, 1895, p. 235.

[2] Two in Am. Mus. Nat. Hist., 2 in Field Mus. Nat. Hist.

REITHRODONTOMYS MEGALOTIS ZACATECÆ Merriam.

MOUNTAIN HARVEST MOUSE.

(Pl. I, fig. 11; Pl. IV, fig. 11.)

Reithrodontomys megalotis zacatecæ Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 557.
Reithrodontomys megalotis obscurus Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 558 (Sierra Madre, near Guadalupe y Calvo, Chihuahua).
Reithrodontomys colimæ Allen, Bull. Am. Mus. Nat. Hist., XXII, 1906, p. 249 (not of Merriam; specimens from Volcan de Fuego, Jalisco).

Type locality.—Valparaiso Mountains, Zacatecas, Mexico.

Distribution.—Mountains of Western Mexico, from southern Chihuahua to Michoacan.

Characters.—Very similar to *arizonensis*, but with darker underparts; smaller and paler than *saturatus*, with less black on upperparts.

Color.—*Adults:* Upperparts ochraceous-buff, heavily mixed with black, the ochraceous color most pronounced on head and sides; the black predominating on dorsal area but not forming a distinct band; underparts washed with ochraceous-buff, this color usually most intense between the fore legs; ears fuscous or dark hair-brown, usually with a blackish patch on lower inner margin; feet whitish or buffy white, ankles dusky; tail sharply bicolor, dark hair-brown above, grayish white beneath. *Young:* Paler and grayer on upperparts; sides with a well-marked lateral line of light ochraceous-buff; underparts whiter.

Skull.—Similar to that of *megalotis* but smaller; rostrum slenderer, narrowed at the tip; zygomata slightly narrower anteriorly; nasals narrowed to a point posteriorly, ending on a line with premaxillæ.

Measurements.—Average of 3 adults from type locality: Total length, 154; tail vertebræ, 84; hind foot, 18.5. Average of 3 adults from Guadalupe y Calvo, Chihuahua: 160; 85; 18. Skull: (See table, p. 81).

Remarks.—This subspecies is a small, dark-colored race of *megalotis* inhabiting the mountains of western Mexico. No specimens have been seen indicating intergradation between *megalotis* and *zacatecæ*, but very likely such material may in the future be secured. Intergradation with *saturatus* is indicated by specimens from the State of Mexico (Salazar, Toluca Valley, etc.) which resemble *saturatus* in color but have smaller ears and skulls intermediate in size between the two forms. From Nahuatzin, Michoacan, specimens nearly typical of both forms are at hand. Some are larger with larger, darker ears and large skulls (as in *saturatus*), but at least 2 adult individuals, by reason of small size, small skull, small ears, and ochraceous underparts, must be referred to *zacatecæ*. Specimens from Patamban, Michoacan, average more intensely ochraceous, especially on the underparts, and have more black on the ears, but are otherwise typical. The series from Guadalupe y Calvo, Chihuahua, forming the basis of "*obscurus*", is too slightly different to warrant recognition. The coloration of the two series is practically the same, and the skulls of "*obscurus*" average only slightly larger.

This subspecies bears a striking resemblance to *longicaudus* from California, but differs in having ochraceous underparts, slightly longer tail, and a little more ochraceous color on the head.

Specimens examined.—Total number, 27, from the following localities in Mexico:

Chihuahua: Sierra Madre, near Guadalupe y Calvo, 3.
Durango: El Salto, 2.
Zacatecas: Valparaiso Mountains, 14.
Michoacan: Nahuatzin, 2; Patamban, 4.
Jalisco: Volcan de Fuego, 2.[1]

REITHRODONTOMYS AMOLES sp. nov.

QUERETARO HARVEST MOUSE.

Type from Pinal de Amoles, Queretaro, Mexico. No. 81234, U. S. Nat. Mus., Biological Survey Collection, ♀ adult, September 20, 1896; E. W. Nelson and E. A. Goldman. Original No. 10169.

Characters.—Similar in color to *R. m. saturatus*, but very much smaller.

Color.—*Worn pelage:* Upperparts mixed blackish and ochraceous-buff; underparts whitish, strongly tinged on pectoral region with ochraceous-buff; tail fuscous above, grayish white below; hind feet whitish; fore feet white with a pronounced dusky stripe on upper surface; ears dark brown (much mutilated, and size not known).

Skull.—Similar to that of *R. m. megalotis* but much smaller; zygomata parallel; bullæ smaller and rather flat.

Measurements.—Type: Total length, 154; tail vertebræ, 83; hind foot 16.5. Skull: (See table, p. 81.)

Remarks.—On geographical grounds this form ought to be close to *R. m. saturatus*, but it differs markedly in size from that race. It is even smaller than *R. m. zacatecæ* of the Sierra Madre, which it somewhat resembles in color.

Specimen examined.—One, the type.

REITHRODONTOMYS CATALINÆ Elliot.

CATALINA HARVEST MOUSE.

Rhithrodontomys catalinæ Elliot, Pub. Field Columb. Mus., Zool. Ser. III, 1903, p. 246.
Reithrodontomys megalotis catalinæ Grinnell, Proc. Cal. Acad. Sci., Ser. 4, III, 1913, p. 304.

Type locality.—Santa Catalina Island, Cal.

Distribution.—Santa Catalina Island, Cal.

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[1] Collection Am. Mus. Nat. Hist.

Characters.—Similar to *longicaudus* but larger and slightly paler.

Color.—*Worn spring pelage:*[1] Upperparts mixed light ochraceous-buff and blackish brown, darkest on back, but without a distinct dorsal stripe; underparts white, tinged with buff in pectoral region; tail dark hair-brown above, white beneath; ears hair-brown, clothed with ochraceous hairs.

Skull.—Larger than that of *R. m. longicaudus*, but not otherwise different.

Measurements.—Average of 10 adults from type locality: Total length, 169 (165–175); tail vertebræ, 94 (90–99); hind foot, 18.6 (18–19.5). Skull: (See table, p. 81).

Remarks.—So far as known this is the only insular species in the genus. Mr. C. P. Streator, who collected a series in 1892, found the mice abundant on the island in brush and cactus.

Specimens examined.—Twenty-eight, from type locality.

REITHRODONTOMYS RAVIVENTRIS RAVIVENTRIS Dixon.

RED-BELLIED HARVEST MOUSE.

(Pl. I, fig. 9; Pl. IV, fig. 9.)

Reithrodontomys raviventris Dixon, Proc. Biol. Soc. Wash., XXI, 1908, p. 197.

Type locality.—Redwood City, Cal.

Distribution.—Salt marshes of San Francisco Bay, Cal.

Characters.—Similar to *R. megalotis longicaudus* but upperparts darker and underparts reddish; skull larger; tail slightly shorter.

Color.—Upperparts mixed black and pinkish cinnamon, the black predominating on dorsal area; sides pale tawny in some individuals; underparts pinkish cinnamon (rarely with a small white spot on chin); ears black or fuscous on both surfaces, with a tuft of ochraceous hairs at anterior base; hind feet and tail usually very dark, varying from fuscous to clove-brown or sepia, the tail slightly paler beneath, but feet usually darker beneath; toes whitish; front feet sepia, often tinged with buffy white.

Skull.—Decidedly larger than that of *R. m. longicaudus;* with relatively shorter rostrum; nasals and palatal foramina shorter; zygomata more widely expanded anteriorly.

Measurements.—Average of 21 from type locality: Total length, 130.7 (120–142); tail vertebræ, 64.8 (56–74); hind foot, 16.6 (15–18). Average of 8 from Melrose Marsh, Alameda County: 137; 66; 17.7. Skull: (See table, p. 81).

Remarks.—This species is remarkable on account of its peculiar characters and limited distribution. It is the darkest form found in the United States and the only one having reddish underparts. In color it most nearly resembles *R. australis* of Costa Rica, but the underparts are even darker than in that species.

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[1] Fresh pelage not seen.

It is apparently confined to the salt marshes in the southern part of San Francisco Bay and although in many places its range abuts on that of *longicaudus*, no evidence of intergradation between them has been discovered. Two specimens—one from Palo Alto and one from Berkeley—have whitish underparts but in other respects are typical *raviventris*. Intergradation with *halicœtes* seems probable. The pelage of both of these marsh forms is longer and seemingly thicker than that of *longicaudus*.

Specimens examined.—Total number, 44, from the following localities:

California: Berkeley, 2; Elmhurst, 1;[1] Melrose Marsh, Alameda County, 13;[1] Palo Alto, 4;[2] Redwood City, 24.[1]

REITHRODONTOMYS RAVIVENTRIS HALICŒTES Dixon.

PETALUMA MARSH HARVEST MOUSE.

(Pl. I, fig. 10; Pl. IV, fig. 10.)

Reithrodontomys halicœtes Dixon, Univ. Cal. Pub. in Zool., V, 1909, p. 271.

Type locality.—Salt marsh 3 miles south of Petaluma, Cal.

Distribution.—Salt marshes of San Pablo Bay, Suisun Bay, and the lower San Joaquin and Sacramento Rivers.

Characters.—Similar in color to *raviventris* but larger; underparts white; ears and feet paler; tail more distinctly bicolor. Compared with *R. m. longicaudus:* Decidedly larger and darker, with a large white patch on the throat; skull larger, with more widely spreading zygomata.

Color.—*Fresh pelage:* Upper parts ochraceous-buff, heavily mixed on the back with black; sides ochraceous-buff without a well-defined lateral line; underparts white (the bases of hairs plumbeous), sometimes irregularly blotched with ochraceous-buff; throat and sides of mouth pure white to base of hairs; sides of nose and eye ring blackish; ears and upper surface of tail fuscous or fuscous-black; underside of tail dull grayish white with a buffy tinge; feet white or buffy white. *Worn pelage:* Decidedly more ochraceous, the black tips of the hairs seemingly worn off.

Skull.—Similar to that of *raviventris;* larger than that of *R. m. longicaudus;* zygomata usually (at least in adults) widely expanded anteriorly.

Measurements.—Average of 13 from type locality: Total length, 156 (149–64); tail vertebræ, 82 (75–85); hind foot 17.7 (17–19). Skull: (See table, p. 81).

Remarks.—This form, although living only a short distance from *raviventris* and under seemingly identical conditions, is readily separable from it. Nor is it in any sense a connecting form between

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[1] Collection Mus. Vert. Zool., Univ. of Cal.

[2] Three from Collection Mus. Vert. Zool.

raviventris and *longicaudus*, being larger than either with upperparts fully as dark as *raviventris*. The underparts are whiter than in *longicaudus*, the latter usually being more or less tinged with pale ochraceous-buff. The close resemblance between *halicœtes* and *raviventris* in skull characters and the fact that nearly half of the specimens of *halicœtes* examined from Petaluma are more or less suffused beneath with ochraceous (though never so completely as in *raviventris*) leads to the belief that the two are subspecifically related. Specimens of *halicœtes* in worn pelage are much redder (less blackish) than those in fresh pelage, thus rather closely resembling in color certain specimens of *longicaudus*.

Mr. Joseph Dixon, who collected the type series of this mouse, states:

> This mouse seems to be restricted to the salt marsh, its range being coextensive with that of the "pickle grass" (Salicornia). Diligent search and trapping failed to reveal its presence outside the Salicornia and no specimens of *R. longicauda* could be caught in the Salicornia. The harvest mice use the runways of Microtus extensively.[1]

Specimens examined.—Total number, 56, from the following localities:

California: Brentwood, 1; Cordelia, Solano County, 6;[2] Grand Island (2 miles north of Knights Landing, Yolo County), 1;[2] Grizzly Island, Solano County, 27;[2] Petaluma, 21.[2]

REITHRODONTOMYS FULVESCENS GROUP.

REITHRODONTOMYS FULVESCENS FULVESCENS Allen.

SONORAN HARVEST MOUSE.

Reithrodontomys mexicanus fulvescens Allen, Bull. Am. Mus. Nat. Hist., VI, 1894, p. 319.
Reithrodontomys fulvescens Allen, Ibid., VII, 1895, p. 138.

Type locality.—Oposura, Sonora, Mexico.

Distribution.—Mountainous parts of southern Sonora, western Chihuahua, and northern Durango.

Characters.—Size medium—a little larger than *R. m. megalotis*, with decidedly longer tail; prevailing color of upperparts ochraceous-buff with a pronounced lateral line.

Color.—Upperparts light ochraceous-buff, sparingly mixed with blackish brown; buff color most strongly marked on sides where it frequently forms a pronounced lateral line, unmixed with brown; front and sides of face tinged with grayish; underparts white, sometimes faintly tinged with pale buff; feet buffy white; ears hair-brown externally, clothed on inner surface with ochraceous-tawny hairs; tail hair-brown above, grayish white beneath.

Skull.—Similar to that of *R. m. megalotis* but slightly larger; interpterygoid fossa broader.

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[1] Univ. of Cal. Pub. in Zool., V, 1909, p. 271.

[2] Collection Mus. Vert. Zool., Univ. of Cal.

Measurements.—Type: Total length, 183; tail vertebræ, 102; hind foot, 19. One specimen (subadult) from Providencia Mines, Sonora: 158.5; 84; 20.5. Average of 4 (adult and subadult) from Casas Grandes, Chihuahua: 165 (157–174); 93 (84–97); 20. Skull: (See table, p. 81).

Remarks.—The mice of this group may be distinguished from *R. m. megalotis* by their greater size, longer tails, and more intensely ochraceous coloration. The present form resembles *megalotis* more closely than do any of the other subspecies and certain specimens of the two forms are colored almost alike on the back. The sides of *fulvescens*, however, are more extensively buffy and less mixed with brown than those of *megalotis*. The skulls of *fulvescens* may usually be distinguished from those of any member of the *megalotis* group by the greater breadth of the interpterygoid fossa.[1] The ranges of the two species meet along the eastern border of the Sierra Madre in Chihuahua, but there is no indication of intergradation between them.

This subspecies was the first member of the group to be described and the third distinctively Mexican species to receive recognition. Although described in 1894, it is still imperfectly known, only a small number of specimens having been collected in the type region. At the time of naming this form Dr. Allen considered it a subspecies of *mexicanus*[2] and noted its close relationship to the Rio Grande form. Later he accorded it specific rank. The abundant material now available from Mexico shows clearly that *fulvescens*, *tenuis*, and *intermedius* are closely related subspecies, connected through central Mexico by a perfect series of intergrades. The present form apparently intergrades, also, with *toltecus*, as indicated by a specimen from Inde, Durango, which agrees with *fulvescens* in color, but has a long tail like *toltecus*, and skull intermediate in size between the two forms. The series from Casas Grandes, Chihuahua, agrees with the type series in external characters, except for a more pronounced grayish wash on the head and shoulders, but the single adult in the series has a somewhat larger skull than any in the Oposura series. In this character it is matched by a specimen from Parral, Chihuahua.

Specimens examined.—Total number, 12, from the following localities in Mexico:

Sonora: Oposura, 3;[3] Providencia Mines, 2.[4]
Chihuahua: Casas Grandes, 5; Parral, 1.
Durango: Inde, 1.[5]

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[1] Skulls of *R. m. saturatus* are sometimes difficult to distinguish by this character from those of *R. f. tenuis*.

[2] The name *mexicanus* at that time was applied to all the mice of this group from Texas and Mexico.

[3] Collection Am. Mus. Nat. Hist.

[4] Collection Field Mus. Nat. Hist.

[5] Approaching *toltecus*.

REITHRODONTOMYS FULVESCENS TENUIS Allen.

MEXICAN HARVEST MOUSE.

(Pl. II, fig. 7; Pl. V, fig. 7.)

Reithrodontomys tenuis Allen, Bull. Am. Mus. Nat. Hist., XII, 1899, p. 15.
Reithrodontomys griseoflavus Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 553 (Ameca, Jalisco).

Type locality.—Rosario, Sinaloa, Mexico.

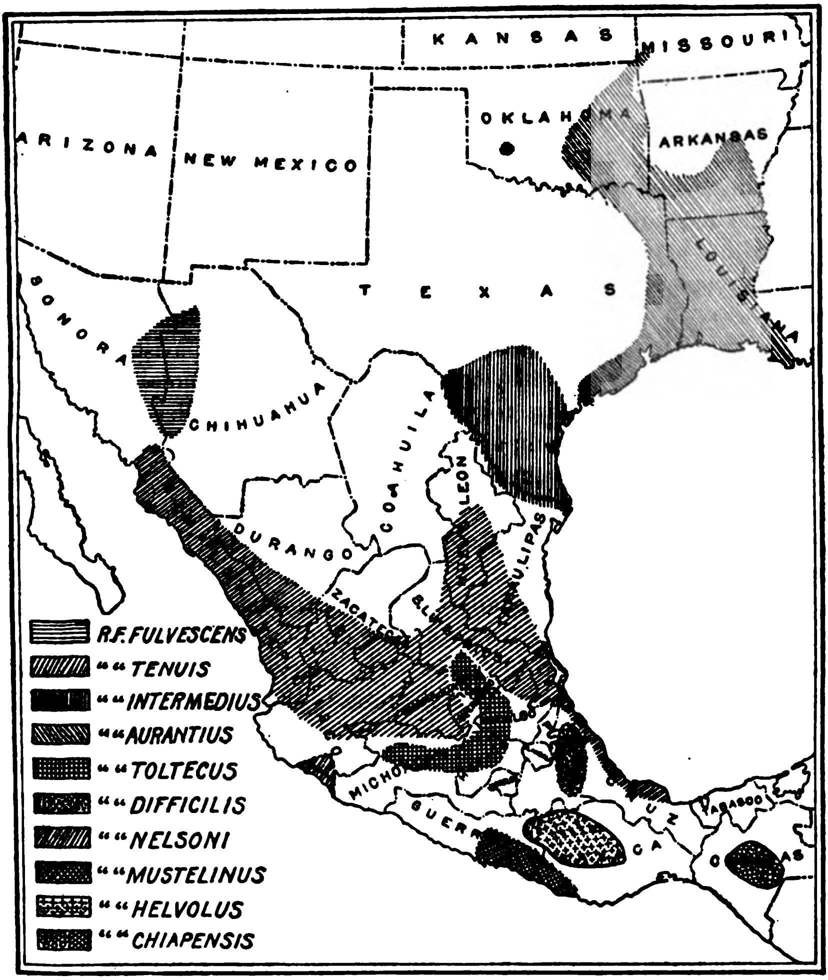

FIG. 3.—Distribution of *Reithrodontomys fulvescens* and subspecies.

Distribution.—Greater part of Mexico, except extreme northern and southern portions; from southern Sonora, Durango, Zacatecas, San Luis Potosi, Nuevo Leon, and central Tamaulipas, south to southern Jalisco, Michoacan, and the coast region of Vera Cruz.

Characters.—Similar to *fulvescens*, but colors darker and more intensely ochraceous.

Color.—Upperparts and sides rich ochraceous-buff; head and shoulders strongly ochraceous, without trace of grayish; back more heavily mixed with black than in *fulvescens;* ears slightly darker; underparts usually grayish white, sometimes faintly tinged with buff; tail hair-brown above, grayish white below.

Skull.—Closely similar to that of *fulvescens.*

Measurements.—Average of 3 adults from Mazatlan, Sinaloa: Total length, 169 (163–177); tail vertebræ, 98 (96–102); hind foot, 20.8 (20.5–21). Average of 5 adults from Chacala, Durango: 177; 105; 21.3. Skull: (See table, p. 81).

Remarks.—This is the most widely distributed member of the *fulvescens* group and over its extensive range shows remarkably little variation. Specimens from opposite sides of the continent can not be distinguished by characters either of skin or skull. There is considerable individual variation in both color and cranial characters, but none which is correlated with distribution.

The subspecies intergrades with *fulvescens* in southern Sonora, with *intermedius* in Nuevo Leon and Tamaulipas, with *difficilis* in Vera Cruz and with *toltecus* in Michoacan. Direct comparison with the type has not been possible, but specimens in the Biological Survey Collection from Mazatlan, forwarded to Mr. G. S. Miller, jr., while he was in London, were compared by him with the type in the British Museum and found to agree very closely with it. Mr. Miller states: "I should say there is no question of the identity of the Mazatlan specimens with *tenuis.*" In making comparisons these specimens have been chiefly used.

Specimens from Ameca, Jalisco, forming the basis of "*griseoflavus,*" show in comparison with *tenuis* a very slight cranial difference, consisting of a more inflated braincase. In this character they resemble *helvolus,* although on geographical grounds they should be approaching *toltecus.* In color and size they agree closely with *tenuis.* The type is decidedly more grayish on the back and less intensely buffy on the sides than is usual in this subspecies, but two topotypes agree perfectly with the Mazatlan specimens of *tenuis.* A series from Chacala, Durango, is a little darker and more richly colored, as well as slightly larger than the typical form. Specimens from the arid coast region of Vera Cruz (Carrizal, Santa Maria, and Catemaco) are clearly intermediate between *tenuis* and *difficilis,* the ears and tails being noticeably darker than in *tenuis* but the underparts and backs paler than in *difficilis.*

Specimens from as far north as Cerro de la Silla and Santa Catarina, Nuevo Leon, are referable to *tenuis,* though those from Santa Catarina might almost as well be considered *intermedius.* Specimens from Acambaro, Michoacan, are intermediate in size between *tenuis* and *toltecus.*

Specimens examined.—Total number, 127, from the following localities in Mexico:

Sinaloa: Sinaloa, 2; Altata, 1; Culiacan, 1; Mazatlan, 4; Rio Mazatlan, 1.
Sonora: Alamos, 6.[1]
Jalisco: Ameca, 3; Atemajac, 2; Estancia, 1;[3] Etzatlan, 6;[3] Lagos, 1; Las Canoas, 2;[2] Los Masos, 1;[2] Mascota, 1; Ocotlan, 2; Plantinar, 2; San Sebastian, 8;[3] Talpa, 1; Zapotlan, 7.
Tepic: Tepic, 2.
Durango: Chacala, 8; Durango, 3.
Zacatecas: Berriozabal, 1; Valparaiso, 5.
San Luis Potosi: Hacienda La Parada, 3.
Queretaro: Jalpan, 2; Tequisquiapam, 2.
Michoacan: Acambaro, 2.
Morelos: Cuernavaca, 1.[4]
Guanajuato: Santa Rosa, 1; Silao, 2.
Vera Cruz: Carrizal, 4; Catemaco, 1; San Carlos, 2;[5] Santa Maria, 4.
Tamaulipas: Alta Mira, 11; Hidalgo, 9; Jaumave, 1; Victoria, 5.
Nuevo Leon: Cerro de la Silla, 3; Santa Catarina, 3.

REITHRODONTOMYS FULVESCENS INTERMEDIUS Allen.

Rio Grande Harvest Mouse.

Ochetodon mexicanus Allen, Bull. Am. Mus. Nat. Hist. III, 1891, p. 223 (not *Reithrodon mexicanus* Sauss.)
Reithrodontomys mexicanus intermedius Allen, Bull. Am. Mus. Nat. Hist., VII, 1895, p. 136.
Reithrodontomys laceyi Allen, Bull. Am. Mus. Nat. Hist., VIII, 1896, p. 235 (Watson's Ranch, 15 miles south of San Antonio, Tex.).
Reithrodontomys intermedius Bailey, N. Am. Fauna No. 25, 1905, p. 104.

Type locality.—Brownsville, Tex.

Distribution.—Southern Texas and adjacent parts of Mexico from Del Rio to Brownsville; east to Bexar and Bee Counties; north to Wichita Mountains, Okla.

Characters.—Very similar to *tenuis* but averaging duller and less intensely ochraceous above, and sides paler. Compared with *fulvescens:* Upper parts, particularly head and shoulders, deeper ochraceous.

Color.—*Winter pelage* (February): Ground color of upperparts light ochraceous-buff, brightest on sides, strongly mixed with blackish brown on the back; ears hair-brown, usually tinged with ochraceous on inner surface; tail hair-brown above, grayish white beneath; feet white; underparts white, sometimes faintly tinged with buff. *Summer* (*worn*) *pelage:* Decidedly redder on back and sides, some specimens approaching dull orange-cinnamon. *Young:* Colors grayer and less ochraceous.

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[1] Approaching *fulvescens*.
[2] Collection Am. Mus. Nat. Hist.
[3] Approaching *nelsoni*.
[4] This specimen seems best referable to this subspecies, although on geographical grounds it should be either *toltecus* or *helvolus*.
[5] Collection Field Mus. Nat. Hist.

Skull.—Very similar to that of *tenuis*, but braincase averaging slightly larger.

Measurements.—Average of 8 adults from Rio Grande Valley (Matamoras and Camargo, Tamaulipas): Total length, 169 (160–181); tail vertebræ, 98 (88–103); hind foot, 20.8 (20–21.5). Skull: (See table, p. 81).

Remarks.—This subspecies is most nearly related to *tenuis*, than which it has a much less extensive range. The differences between *intermedius* and *tenuis* are really very slight, consisting in a more intense suffusion of ochraceous-buff in *tenuis*, especially noticeable on the sides. Specimens from Bexar and Kerr Counties—the type region of "*laceyi*"—average slightly grayer and less ochraceous than specimens from the mouth of the Rio Grande, but individuals in each series may be matched by those from the other and the differences seem too slight to warrant recognition of the form. If both *intermedius* and "*laceyi*" were to be recognized, the former would be nothing more than a series of intermediates between *tenuis* on the one side and "*laceyi*" on the other.

Specimens examined.—Total number, 65, from the following localities:

Oklahoma: Mount Scott, 9.
Texas: Brownsville, 26; Corpus Christi, 2; Del Rio, 2; Lacey's Ranch, near Kerrville, 4; Padre Island, 1; Rio Grande City, 1; San Antonio, 3; San Diego, 5; Santo Tomas, 2.
Tamaulipas: Camargo, 4; Matamoros, 6.

REITHRODONTOMYS FULVESCENS AURANTIUS Allen.

Golden Harvest Mouse.

Reithrodontomys mexicanus aurantius Allen, Bull. Am. Mus. Nat. Hist., VII, 1895, p. 137.
Reithrodontomys chrysotis Elliot, Field Columb. Mus., Zool. Ser., I, 1899, p. 281 (Dougherty, Okla.).
Reithrodontomys aurantius Bailey, N. Am. Fauna No. 25, 1905, p. 105.

Type locality.—Lafayette, La.

Distribution.—Louisiana (west of the Mississippi River), southern and east-central Arkansas, eastern Texas, and eastern Oklahoma; north to southwestern Missouri (Carthage). Confined to Lower Austral Zone.

Characters.—Colors decidedly richer and darker than in *intermedius;* skull slightly larger.

Color.—*Adults in unworn pelage:* Upperparts varying from pinkish innamon to ochraceous-tawny, usually heavily mixed with blackish n; sides of head and body usually rich ochraceous or tawny but t a pronounced lateral line where the color of the sides meets the underparts; dark markings of back frequently forming a

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distinct median band; ears dull sepia, clothed on inner surface with tawny hairs; underparts grayish white, often with a distinct tinge of pale buff. *Immature pelage:* Decidedly more grayish, often lacking entirely the bright tawny shades. *Variation:* There is considerable variation in color in this subspecies, even among adult specimens. This consists both in the intensity of the ochraceous shades and in the amount of blackish suffusion on the back and sides. Some individuals have the whole back heavily sprinkled with blackish hairs, while others show only a rather narrow band down the median line. A specimen from Matagorda Island (March 31) is quite exceptional in being intensely tawny over the entire upperparts with only faint indications of black hairs on the back, thus closely resembling specimens of *Peromyscus nuttalli.* Other individuals from the same island are normal in color.

Skull.—Very similar to that of *intermedius*, but braincase averaging a little broader.

Measurements.—Adult from Houma, La.: Total length, 176; tail vertebræ, 100; hind foot, 20. Average of 5 adults from Velasco, Tex.: 170; 97; 21. Average of 9 young adults from Sour Lake, Tex.: 162 (154–170); 89 (83–94); 20 (19–21). Skull: (See table, p. 81).

Remarks.—This subspecies is a well-marked race, occupying the humid or Austroriparian division of the Lower Austral Zone, west of the Mississippi River. Although it shows considerable individual variation and occasional specimens—chiefly immature ones—are hardly distinguishable from specimens of *intermedius*, the general intensity of coloration shown by any series of specimens makes identification possible at a glance. The type and topotypes of "*chrysotis*" have been examined and found to agree perfectly with specimens of *aurantius* from eastern Texas.

Specimens examined.—Total number, 88, from the following localities:

Louisiana: Avery, 5; Belcher, 1; Foster (5 miles east of Shreveport) 1; Houma, 1; Iowa Station, 1; Lafayette, 2; Lecompte, 1 (skull); Mer Rouge, 4; Natchitoches, 1.

Arkansas: Beebe, 2; Delight, 4.

Missouri: Carthage, 2.

Oklahoma: Dougherty, 3;[1] Stilwell, 3.

Texas: Barnard Creek, west of Columbia, 6; East Caranchua Creek, Matagorda County, 2; Elliott, Matagorda County, 1; Hempstead, 8; Joaquin, 7; Matagorda, 5; Matagorda Island, 5; Nacogdoches, 2; Selkirk Island, Matagorda County, 1; Sour Lake, 10; Texarkana, 1; Velasco, 9.

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[1] Collection Field Mus. Nat. Hist.

REITHRODONTOMYS FULVESCENS DIFFICILIS Merriam.

ORIZABA HARVEST MOUSE.

(Pl. II, fig. 8; Pl. V, fig. 8.)

? ? *Reithrodon sumichrasti* De Saussure, Rev. Mag. Zool., 2d Ser., XIII, 1861, p. 3.[1]
Ochetodon mexicanus Coues, Proc. Acad. Nat. Sci. Phila., 1874, p. 186; Mon. N. Am. Rodentia, 1877, pp. 128–130. (Not *Reithrodon mexicanus* Sauss.)
Reithrodontomys mexicanus Allen, Bull. Am. Mus. Nat. Hist., VII, 1895, p. 135; IX, 1897, p. 199 (not *Reithrodon mexicanus* Sauss).
Reithrodontomys difficilis Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 556.

Type locality.—Orizaba, Vera Cruz.

Distribution.—Interior mountain slopes along the southern end of the Mexican table-land in the States of Vera Cruz and Puebla.

Characters.—Similar to *tenuis*, but colors decidedly darker; ears and tail blacker, and underparts more ochraceous.

Color.—Upperparts pinkish cinnamon mixed with blackish brown, in some specimens the brown prevailing, in others the cinnamon; sides of face and body usually clear pinkish cinnamon, though in certain worn or immature specimens this color is nearly absent; ears fuscous or sepia, usually with more or less tawny hairs on inner surface; tail fuscous above, grayish white below; underparts grayish, with a strong wash of light pinkish cinnamon, the latter color prevailing in the majority of the individuals; feet grayish white; ankles dusky.

Skull.—Closely similar to that of *tenuis*; braincase averaging a trifle broader. Compared with *R. megalotis saturatus:* Skull shorter and relatively broader, with shorter nasals and broader interpterygoid fossa.

Measurements.—Average of 5 (subadult) from type locality: Total length, 170 (162–177); tail vertebræ, 96.6 (88–101); hind foot, 19.5 (19–20). Adult from Maltrata, Vera Cruz: 172; 97; 21. Skull: (See table, p. 81).

Remarks.—This is the darkest of the races of *fulvescens*. Although rather restricted in range, it is a well-marked form, easily distinguished from *tenuis* by its darker colors, but intergradation is clearly shown by specimens from the coast region of Vera Cruz (Carrizal and Santa Maria). From *R. megalotis saturatus*, the range of which is adjacent to that of *difficilis* in Vera Cruz, it differs in more tawny coloration, ochraceous instead of grayish underparts, and smaller and paler ears.

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[1] When the type of *R.* "*sumichrasti*" can be compared with modern material it may be possible to identify the species and use the name. I have seen photographs of the type skull, which clearly show it to belong in the typical subgenus, and the original description agrees best with the present form; but as no definite type locality is assigned and the description is inadequate for subspecific determination, it seems best to let the name remain in synonymy.

Specimens examined.—Total number, 36, from the following localities in Mexico:

Vera Cruz: Maltrata, 1; Orizaba, 18; Mirador, 2; Jalapa, 14.[1]
Puebla: Tehuacan, 1.

REITHRODONTOMYS FULVESCENS TOLTECUS Merriam.

TOLTEC HARVEST MOUSE.

(Pl. II, fig. 10; Pl. V, fig. 10.)

Reithrodontomys levipes toltecus Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 555.
Rhithrodontomys inexspectatus Elliot, Field Columb. Mus., Zool. Ser., III, 1903, p. 145 (Patzcuaro, Michoacan).

Type locality.—Tlalpam, Federal District, Mexico.

Distribution.—Table-land region of southern Mexico, from southern San Luis Potosi to Michoacan and the Valley of Mexico.

Characters.—Similar to *tenuis*, but decidedly larger and slightly darker.

Color.—Upperparts mixed black and rich ochraceous-buff, with a cinnamon tinge, the black usually showing a tendency to form a median band on the back from nose to tail; sides pure ochraceous-buff or sparingly mixed with black; underparts with a slight tinge of pale buff; tail fuscous or hair-brown above, grayish white below.

Skull.—Similar in shape to that of *tenuis* but decidedly larger; braincase somewhat more inflated, and evenly rounded; rostrum long and relatively slender; zygomata nearly parallel to axis of skull.

Measurements.—Average of 2 adults from type locality: Total length, 193 (189–196); tail vertebræ, 106 (104–108); hind foot, 21.5 (21–22). One adult from Patzcuaro, Michoacan: 180; 105; 21. Average of 2 adults from Rio Verde, San Luis Potosi: 192; 110; 21.8. Skull: (See table, p. 81).

Remarks.—This is a well-marked form of the *fulvescens* group, occupying the higher parts of the Mexican table-land. It is poorly represented in the material at hand, and its characters and exact distribution are not well known. Skulls from the same or near-by localities show an unusual amount of variation in size.

Intergradation apparently takes place between *toltecus* and *tenuis* and between *toltecus* and *helvolus*, but the material at hand is too scanty to show this clearly. Specimens from Rio Verde, San Luis Potosi, and from Zamora and Los Reyes, Michoacan, are considered intermediates between this form and *tenuis*, and specimens from Huajuapam, Oaxaca, and Chilpancingo, Guerrero, intermediates between it and *helvolus*. The series from Los Reyes is very puzzling. In color the specimens are all exactly alike, being a little darker and redder than either *tenuis* or typical *toltecus*. One specimen, an adult male, equals *toltecus* in size and agrees perfectly with it in skull characters. Several other skulls in the series, however, equally old, are very much smaller—as small, indeed, as typical *tenuis*, while between the two extremes is a nearly perfect series of intergrades.

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[1] Collection Am. Mus. Nat. Hist.

Two specimens from Patzcuaro, Michoacan, including the type of "*inexspectatus*," do not differ appreciably from *toltecus*. The topotype has the underparts strongly suffused with ochraceous and has no white on the tail. This species differs widely in skull characters from *levipes*, with which it was originally associated as a subspecies.

Specimens examined.—Total number, 30, from the following localities in Mexico:

Mexico: Tlalpam, 3.
Hidalgo: Marques, 1 (skull); Zimapan, 1.
San Luis Potosi: Rio Verde, 6.
Michoacan: Los Reyes, 13; Patzcuaro, 2;[1] Zamora, 4.

REITHRODONTOMYS FULVESCENS HELVOLUS Merriam.

OAXACA HARVEST MOUSE.

(Pl. II, fig. 9; Pl. V, fig. 9.)

Reithrodontomys griseoflavus helvolus Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 554.

Type locality.—Oaxaca City, Oaxaca, Mexico.

Distribution.—Interior plateau of Oaxaca, Guerrero, and Puebla.

Characters.—About the size of *toltecus* but differing in paler colors, larger ears, and smaller skull; very similar to *tenuis*, but color of back and sides more pinkish (less ochraceous) and belly whiter.

Color.—Upperparts light ochraceous-salmon, sparingly lined with black but without a distinct median band; underparts white, often with a slight yellowish tinge, but never (in type series) with any suffusion of ochraceous. Ears dark hair-brown, clothed on inner surface with ochraceous hairs; tail fuscous or hair-brown, soiled whitish below.

Skull.—Smaller than that of *toltecus* and slightly larger than that of *tenuis;* braincase rounded and moderately inflated, narrowed posteriorly; rostrum rather short; interpterygoid fossa actually and relatively broader than in either *toltecus* or *tenuis*.

Measurements.—Average of 11 adults from type locality: Total length, 189 (181–200); tail vertebræ, 110 (104–116); hind foot, 20.5 (20–21); ear, 13.2 (12.5–13.7). Skull: (See table, p. 81).

Remarks.—This subspecies agrees in size with *toltecus*, but most nearly approaches *tenuis* in color and cranial characters. No intermediate specimens between *helvolus* and *tenuis* have been examined, however, and our present knowledge of the distribution indicates a gap between the ranges of these two forms, but further collecting in Michoacan and Guerrero may show that they intergrade. From *toltecus* this form differs, as already pointed out, in having a decidedly smaller skull, larger ears, and whiter belly. A specimen from Huajuapam, Oaxaca, is intermediate in characters between the two forms.

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[1] Including type of "*inexspectatus*" from Collection Field Mus. Nat. Hist.

Specimens examined.—Total number, 22, from the following localities in Mexico:

Oaxaca: Huajuapam, 1; Oaxaca, 18; Yalalag, 1.
Guerrero: Tlalixtaquilla, 1; Tlapa, 1.

REITHRODONTOMYS FULVESCENS CHIAPENSIS subsp. nov.

CHIAPAS HARVEST MOUSE.

Type from Canjob, Chiapas, Mexico. No. 132865, U. S. Nat. Mus., Biological Survey Collection, ♂ adult, May 2, 1904; Nelson and Goldman. Original No. 16741.

Distribution.—Highlands of Chiapas.

Characters.—Similar to *helvolus* but darker and smaller, with smaller ears.

Color.—Upperparts ochraceous-salmon heavily lined on back with black hairs; lateral line of salmon moderately well defined; ears fuscous; underparts grayish white; tail fuscous above, soiled whitish below; feet grayish; ankles fuscous.

Skull.—Not appreciably different from that of *helvolus.*

Measurements.—Average of 8 adults from type locality: Total length, 169 (163–183); tail vertebræ, 96 (92–102); hind foot, 20.1 (20–20.5); ear, 14. Skull: (See table, p. 81).

Remarks.—This is a small dark form apparently most nearly related to *helvolus.* In size and general color it resembles *tenuis* rather closely, but is darker, especially on the head and ears. It is almost as dark above as *difficilis,* but has whiter underparts. It closely resembles *aurantius* also, but the underparts are more nearly pure white (never tinged with buff), and the general tone of the upperparts is slightly paler. The skull of *chiapensis* averages a little broader with flatter braincase and shorter nasals than that of *aurantius.*

Specimens examined.—Total number, 17, from the following localities in Mexico:

Chiapas: Canjob, 9; Comitan, 4; San Bartolome, 3; San Vicente, 1.

REITHRODONTOMYS FULVESCENS NELSONI subsp. nov.

NELSON HARVEST MOUSE.

Type from Colima, Colima, Mexico. No. $\frac{33408}{45432}$, U. S. Nat. Mus., Biological Survey Collection, ♀ adult, Mar. 9, 1892; E. W. Nelson. Original No. 2050.

Distribution.—Coast region of Colima (and Jalisco?).

Characters.—Smilar to *tenuis*, but smaller; colors brighter and more intensely ochraceous.

Color.—*Adults:* Upperparts varying from deep ochraceous-buff to pinkish cinnamon, mixed on top of head and back with black; underparts suffused (sometimes heavily) with pinkish buff; ears dusky hair-brown; tail dark hair-brown or fuscous above, grayish white below; fore feet pale buff; hind feet soiled whitish. *Young:* Colors less intensely ochraceous; underparts whiter.

Skull.—Similar to that of *tenuis*, but smaller; zygomata more contracted anteriorly.

Measurements.—Type: Total length, 173; tail vertebræ, 95; hind foot, 19. Average of 5 from type locality: 166; 92; 19.2. Skull: (See table, p. 81).

Remarks.—This subspecies is a small, bright-colored form occupying the coast plain of Colima and perhaps of adjacent States. Specimens from San Sebastian and Etzatlan, Jalisco, are intermediate between this form and *tenuis*, but seem to be nearer to the latter. A single specimen from Acaponeta, Tepic, is very small, and clearly referable to *nelsoni*, although on geographical grounds it might be expected to be *tenuis*.

Specimens examined.—Total number, 8, from the following localities in Mexico:

Colima: Colima, 7.
Tepic: Acaponeta, 1.

REITHRODONTOMYS FULVESCENS MUSTELINUS subsp. nov.

BUFF-BELLIED HARVEST MOUSE.

Type from Llano Grande, Oaxaca, Mexico. No. 71549, U. S. Nat. Mus., Biological Survey Collection, ♀ adult, February 18, 1895; E. W. Nelson and E. A. Goldman. Original No. 7483.

Distribution.—Coast region of Oaxaca and Guerrero.

Characters.—Similar to *helvolus* but colors darker and richer; underparts buffy.

Color.—Upperparts varying from ochraceous-salmon to rich pinkish cinnamon, heavily mixed on head and back with black; underparts strongly suffused with pinkish buff; ears hair-brown; tail fuscous above, whitish beneath; fore feet buffy white; hind feet grayish white.

Skull.—Similar in size and proportions to that of *helvolus;* nasals longer, narrowed to a point posteriorly; palatal foramina short, not reaching plane of molars; bullæ small.

Measurements.—Type: Total length, 184; tail vertebræ, 105; hind foot, 20. Adult from Chilpancingo, Guerrero: 198; 110; 20. Skull: (See table, p. 81).

Remarks.—This subspecies is most nearly related to *helvolus*, differing from it in much deeper coloration. It resemples *R. levipes* rather closely in external appearance, but differs widely from it in skull characters. A specimen from Chilpancingo, Guerrero, has a longer skull than the type, somewhat suggesting the skull of *toltecus*.

Specimens examined.—Total number, 4, from the following localities in Mexico:

Oaxaca: Llano Grande, 2.
Guerrero: Acapulco, 1; Chilpancingo, 1.

REITHRODONTOMYS AMŒNUS Elliot.

TEHUANTEPEC HARVEST MOUSE.

(Pl. II, fig. 1; Pl. V, fig. 1.)

Rhithrodontomys amœnus Elliot, Proc. Biol. Soc. Wash., XVIII, 1905, p. 234.

Type locality.—Reforma, Oaxaca, Mexico.

Distribution.—Known only from the type locality.

Characters.—Size very small; tail moderate; similar in color to *R. f. helvolus* but upperparts deeper ochraceous.

Color.—Upperparts bright ochraceous-buff, becoming tawny-ochraceous on middle of the back, where indistinctly lined with black; underparts and feet white; tail hair-brown above, paler below.

Skull.—Small, with short heavy rostrum; braincase moderately flat and narrowed posteriorly; zygomata slightly contracted anteriorly; bullæ small and flat; interpterygoid fossa very broad; palatal foramina long, reaching behind plane of molars.

Measurements.—Type: Total length, 141; tail vertebræ, 81; hind foot, 18.5. Skull: (See table, p. 81).

Remarks.—This species, known from only a single specimen, seems not to be closely related to any of the recognized forms. It most nearly resembles *R. f. helvolus* in color, but differs widely from it in size and cranial characters, being decidedly smaller than any other species in southern Mexico. It inhabits the low coast plain bordering the Gulf of Tehuantepec in southern Oaxaca.

Specimen examined.—One, the type.

REITHRODONTOMYS OTUS Merriam.

BIG-EARED HARVEST MOUSE.

(Pl. II, fig. 2; Pl. V, fig. 2.)

Reithrodontomys levipes otus Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 555.

Type locality.—Sierra Nevada de Colima, Jalisco, Mexico (altitude 6,500 feet).

Distribution.—Known only from the type locality.

Characters.—Similar to *R. f. toltecus*, but tail longer and ears larger; colors more ochraceous and less blackish.

Color.—Upperparts pinkish cinnamon with an ochraceous tinge, mixed with brownish black; underparts heavily washed with light pinkish cinnamon; sides without a distinct lateral line of ochraceous; ears between fuscous and hair-brown with scattering ochraceous hairs on inner surface; front feet dull buffy white; hind feet grayish, with a tinge of buff; ankles dark hair-brown; tail hair-brown above, soiled whitish below.

Skull.—Similar in size and shape to that of *R. f. toltecus* but braincase flatter and zygomata narrowed anteriorly; nasals and premaxillæ as in *toltecus;* audital bullæ also similar (larger than in *R. levipes*); foramen magnum very large; molars with simple enamel pattern, as in the *fulvescens* group.

Measurements.—Type: Total length, 202; tail vertebræ, 120; hind foot, 22. Skull: (See table, p. 81).

Remarks.—This seems to be a well-marked species, but as only a single specimen is known its relationships are not clear. In skull characters it resembles *R. f. toltecus* rather closely and differs from *R. levipes* in having a longer, narrower skull, with larger bullæ and no subsidiary enamel loops on the upper molars, being therefore in the typical subgenus. The ground color of the upperparts is similar to that of *toltecus*, but is a little duller and the blackish median band is lacking; the underparts are decidedly more ochraceous. There is no evidence to show that it intergrades with *toltecus*, so for the present it seems best to consider it a distinct species. The simple enamel pattern of the molars shows it to be not closely related to *levipes*, which is in the subgenus *Aporodon.*

Specimen examined.—One, the type.

REITHRODONTOMYS RUFESCENS GROUP.

REITHRODONTOMYS RUFESCENS RUFESCENS Allen & Chapman.

RUFESCENT HARVEST MOUSE.

Reithrodontomys rufescens Allen & Chapman, Bull. Am. Mus. Nat. Hist., IX, 1897, p. 199.

Type locality.—Jalapa, Vera Cruz, Mexico.

Distribution.—Mountain slopes of eastern Mexico in the States of Queretaro, Hidalgo, Puebla, Vera Cruz, and Oaxaca.

Characters.—Larger than *R. fulvescens difficilis* and much darker; sides lacking the bright ochraceous line characteristic of the *fulvescens* group; tail blackish, unicolor.

Color.—*Fresh pelage* (April specimens, Jalapa, Vera Cruz): Upperparts tawny, strongly mixed with black over the entire dorsal area from nose to tail; sides nearly pure tawny; ears varying from fuscous to fuscous-black; feet buffy white washed with fuscous; tail fuscous, nearly unicolor, clothed with scattered grayish hairs; underparts heavily washed with pinkish cinnamon. *Worn pelage* (July specimens, Jico, Vera Cruz): Underparts somewhat paler; ears and tail blacker.

Skull.—Larger than that of *R. fulvescens difficilis*, with longer and relatively slenderer rostrum; braincase usually subglobular (occasionally moderately flattened); nasals long and narrowed posteriorly to a point, ending about on a line with premaxillæ; zygomata moderately contracted anteriorly; audital bullæ relatively small; palatal foramina long, reaching to or beyond plane of first molars. Enamel pattern of upper molars in some specimens simple, in others showing incomplete subsidiary loops and small accessory tubercles.

Measurements.—Average of 10 adults from Jico and Jalapa, Vera Cruz: Total length, 176 (168–182); tail vertebræ, 98 (93–104); hind foot, 20 (18–21). Skull: (See table, p. 81).

Remarks.—This subspecies is one of the darkest forms in the genus. It has a rather limited range in the humid mountainous parts of eastern Mexico, intergrading with *luteolus* in Oaxaca and Guerrero. Its range overlaps slightly that of *R. fulvescens difficilis* (both species occurring at Jalapa, Vera Cruz), but it does not intergrade with any member of the *fulvescens* group. It is readily distinguished from them by its dark tawny coloration and unicolor tail.

In dental characters this species is quite inconstant, as pointed out above; it is considered an aberrant member of the subgenus *Reithrodontomys*, bridging the gap between it and *Aporodon* in much the same way that *levipes* does.

Specimens examined.—Total number, 15, from the following localities in Mexico:

Vera Cruz: Jalapa, 10;[1] Jico, 8.
Puebla: Huauchinango, 3.
Queretaro: Pinal de Amoles, 1.
Oaxaca: Reyes, 1.

REITHRODONTOMYS RUFESCENS LUTEOLUS subsp. nov.

YELLOW HARVEST MOUSE.

(Pl. II, fig. 6; Pl. V, fig. 6.)

Type from Juquila, Oaxaca, Mexico (altitude 5,000 feet). No. 71558, U. S. Nat. Mus., Biological Survey Collection, ♀ adult, Feb. 28, 1895; E. W. Nelson and E. A. Goldman. Original No. 7579.

Distribution.—Mountains of Oaxaca and Guerrero.

Characters.—Similar to *rufescens* but colors brighter and less blackish; ears larger and tail longer; skull with flattened braincase; molars without accessory cusps.

Color.—Upperparts and sides rich ochraceous-buff, varying to pinkish cinnamon, more or less darkened on the back with blackish brown; underparts light pinkish cinnamon; tail usually bicolor, fuscous above, soiled whitish below; fore and hind feet whitish, tinged with buff; ankles dusky; ears fuscous on both surfaces.

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[1] Collection Am. Mus. Nat. Hist.

Skull.—Similar to that of *rufescens* but averaging broader; braincase very flat; nasals decidedly narrow posteriorly, ending on a line with premaxillæ; audital bullæ rather small (as in *rufescens*).

Measurements.—Average of 8 adults from type locality: Total length, 181 (169–199); tail vertebræ, 103 (92–112); hind foot, 20.4 (20–21). Skull: (See table, p. 81).

Remarks.—This subspecies is a well-marked race of *rufescens*, occupying the mountains of the west coast of southern Mexico. It closely resembles *R. colimæ nerterus* in color, but differs from it in skull characters. Additional material, however, may show that *nerterus* intergrades with the present form.

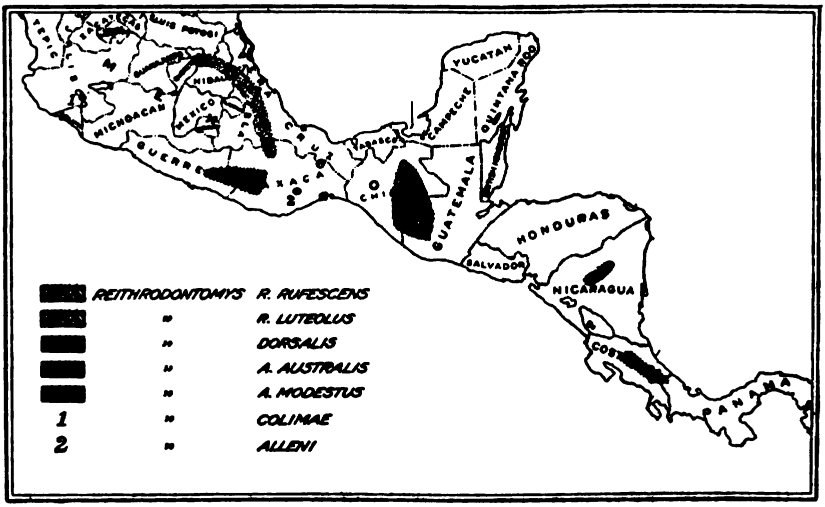

FIG. 4. Distribution of *Reithrodontomys rufescens*, *R. dorsalis*, *R. australis*, *R. colimæ*, *R. alleni*, and subspecies.

Specimens from Omilteme, Guerrero, are slightly darker than the type series and one of them has a unicolor tail, as in *rufescens*. These specimens, as also one from the mountains west of Oaxaca City, are considered intermediate between *rufescens* and *luteolus*. Specimens from the type locality of this form show no approach to the subgenus *Aporodon*, but in the series from Omilteme is one specimen having well-developed subsidiary tubercles, as is frequently seen in the subspecies *rufescens*.

Specimens examined.—Total number, 15, from the following localities in Mexico:

Oaxaca: Juquila, 11; mountains 15 miles west of Oaxaca, 1.
Guerrero: Omilteme, 3.

REITHRODONTOMYS ALLENI sp. nov.

ALLEN HARVEST MOUSE.

Type from mountains near Ozolotepec, Oaxaca, Mexico (altitude 10,000 feet). No. 71563, U. S. Nat. Mus., Biological Survey Collection, ♂ adult, Mar. 27, 1895; E. W. Nelson and E. A. Goldman. Original number 7749.

Distribution.—Known only from the type locality.

Characters.—Externally similar to *R. c. colimæ* but back darker, underparts whiter, and tail longer; skull apparently nearest to that of *R. rufescens luteolus.*

Color.—Upperparts mixed black and light pinkish cinnamon; darkest along the median line; sides without a lateral line, less richly colored than in *colimæ* and much less so than in *luteolus*; underparts white; ears pale fuscous; tail fuscous above, slightly paler beneath; front feet buffy white; hind feet grayish white, washed with hair-brown; ankles dusky.

Skull.[1]—Apparently similar to that of *luteolus*, but smaller; bullæ similar; rostrum short and broad; nasals longer than premaxillæ and narrowed to a point at posterior end; zygomata standing out rather squarely; molars without accessory enamel loops.

Measurements.—Type: Total length, 182; tail vertebræ, 100; hind foot, 19. Skull: (See table, p. 81).[1]

Remarks.—This species, although living at a high altitude and somewhat resembling in color one of the members of the *chrysopsis* group, nevertheless seems to be most nearly related to *R. rufescens luteolus*, which occupies the lower foothill country below the range of *alleni*. The skull of *alleni* resembles that of *luteolus* in having small bullæ and long nasals narrowed posteriorly. Externally *alleni* is paler than *luteolus* and has white underparts. Additional material may show it to be a subspecies of the latter. The species is named for Dr. J. A. Allen, in recognition of his extensive work on the genus.

Specimen examined.—One, the type.

REITHRODONTOMYS COLIMÆ COLIMÆ Merriam.

COLIMA VOLCANO HARVEST MOUSE.

(Pl. II, fig. 5; Pl. V, fig. 5.)

Reithrodontomys colimæ Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 551.

Type locality.—Sierra Nevada de Colima, Jalisco, Mexico (altitude, 12,000 feet).

Distribution.—Known only from the type locality.

Characters.—Externally similar to *R. c. chrysopsis*, with long, woolly pelage, but smaller and paler; skull similar to that of *R. c. tolucæ*, but smaller and with simple enamel pattern.

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[1] Type and only specimen badly broken; shape of braincase not known.

Color.—Upperparts dull ochraceous-buff (slightly paler than in *chrysopsis*), sparingly mixed with black on the back, the median dorsal band only faintly indicated; sides paler but without lateral line of buff; ears fuscous; underparts pinkish buff; fore feet buffy white, washed with brownish; hind feet hair-brown, becoming white toward the toes; tail pale fuscous above, grayish white beneath.

Skull.—Similar in shape to that of *R. c. tolucæ*, but slightly smaller, with less inflated braincase; rostrum a little shorter and broader; zygomata standing out a little more squarely anteriorly; nasals long, ending on plane of premaxillæ; interpterygoid fossa rather wide (as in *chrysopsis*); bullæ intermediate in size between those of *chrysopsis* and *tolucæ*; palatal foramina short and widely open; enamel pattern of upper molars simple, with only a trace of a subsidiary enamel loop.

Measurements.—Average of 2 specimens from type locality: Total length, 165.5; tail vertebræ, 90; hind foot, 20. Skull: (See table, p. 81).

Remarks.—This species resembles externally the members of the *chrysopsis* group, but the absence of sudsidiary loops on the upper molars makes it necessary to place it in the *rufescens* group in the typical subgenus. It is apparently a connectant species between the two subgenera.

Specimens examined.—Two, from type locality.

REITHRODONTOMYS COLIMÆ NERTERUS Merriam.

Colima Harvest Mouse.

Reithrodontomys colimæ nerterus Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 551.

Type locality.—Sierra Nevada de Colima, Jalisco, Mexico (altitude, 6,500 feet).

Distribution.—Known only from the type locality.

Characters.—Similar to *colimæ*, but ochraceous color more intense, pelage shorter, and tail longer; skull slightly smaller.

Color.—Upperparts deep ochraceous-buff, nearly pure on sides, mixed with black on median dorsal area; underparts heavily washed with light ochraceous-buff; ears fuscous, shading to fuscous-black; tail indistinctly bicolor, pale fuscous above, dusky drab below; feet buffy white, shaded with dusky; ankles dark hair-brown.

Skull.—Slightly smaller than that of *colimæ* but of essentially similar shape; nasals considerably shorter; interpterygoid fossa relatively wide; enamel pattern of upper molars simple. Compared with *luteolus:* Braincase narrower and higher; rostrum slenderer; nasals broader at posterior end; bullæ smaller but more inflated (rounder); palatal foramina shorter. Compared with *R. r. rufescens:* Braincase higher; rostrum and nasals shorter; bullæ more inflated.

Measurements.—Type (♀ ad.): Total length, 190; tail vertebræ, 110; hind foot, 20; ear from notch, 14.5; topotype (♂ ad.): 182; 99; 21. Skull: (See table, p. 81).

Remarks.—This form closely resembles *R. rufescens luteolus*, both in color and in the character of the pelage, which is shorter and less wooly than in *R. colimæ colimæ*, which lives at higher altitudes. Compared with *luteolus* the present form is a slightly paler shade of ochraceous-buff. Its skull characters indicate close relationship to *colimæ* and necessitate its separation from *luteolus*, but additional material may serve to connect the two groups, making *luteolus* a subspecies of *colimæ*.

Specimens examined.—Two, from type locality.

REITHRODONTOMYS DORSALIS Merriam.

BLACK-BACKED HARVEST MOUSE.

(Pl. II, fig. 4; Pl. V, fig. 4.)

Reithrodontomys dorsalis Merriam, Proc. Wash. Acad. Sci, III, 1901, p. 557.

Type locality.—Calel, Guatemala.

Distribution.—Highlands of Chiapas and Guatemala.

Characters.—Smaller than *R. rufescens luteolus*, with blacker back and paler sides; skull with higher braincase.

Color.—*Fresh pelage* (January): Upperparts ochraceous-buff, mixed with black, with a well-defined median band or stripe of black; sides varying from ochraceous-buff to pinkish cinnamon, sometimes with a rather pronounced lateral line next to the belly; underparts washed with light ochraceous-buff; ears fuscous-black, darker than in *luteolus;* tail bicolor, fuscous above, grayish white beneath; hind feet grayish white; front feet buffy with a dusky stripe reaching halfway to the toes. *Worn pelage:* General tone redder (pinkish cinnamon to pale tawny); black dorsal area much less clearly defined.

Skull.—Resembling that of *R. r. rufescens* in general shape, but averaging smaller, with larger bullæ. Compared with *R. r. luteolus:* Smaller; braincase decidedly more inflated; interpterygoid fossa much narrower. Compared with *saturatus:* Larger, with heavier rostrum and more widely expanded zygomata. The upper molars in a majority of the specimens examined have a simple enamel pattern, but some specimens show an incomplete subsidiary loop and well-developed accessory tubercles on the outer border, thus completely bridging the gap between the two subgenera.

Measurements.—Average of 10 specimens (adult and subadult) from type locality: Total length,167.5 (160–175); tail vertebræ, 90 (82–96); hind foot, 19.3 (19–20). Skull: (See table, p. 81).

Remarks.—This species, although clearly belonging to the *rufescens* group, seems not to intergrade with *luteolus*, its nearest neighbor on the north. The low country on the Isthmus of Tehuantepec apparently is an effective barrier separating the ranges of these two mountain-loving species.

The species exhibits considerable individual and seasonal variation in color. Specimens in worn pelage very much resemble similar specimens of *rufescens*, but the ears and tail are paler.

Specimens examined.—Total number, 154, from the following localities:

Guatemala: Calel, 23; Hacienda Chancol, 29; Jacaltenango, 1; Todos Santos, 10; Volcan Santa Maria, 4; Zunil, 3.

Chiapas: Canjob, 2; Comitan, 27; Pinabete, 8; San Cristobal, 5; Tenejapa, 3; Teopisca, 6; Tumbala, 33.

REITHRODONTOMYS AUSTRALIS AUSTRALIS Allen.

IRAZU HARVEST MOUSE.

(Pl. II, fig. 3; Pl. V, fig. 3.)

Reithrodontomys australis Allen, Bull. Am. Mus. Nat. Hist., VII, 1895, p. 328.

Reithrodontomys australis vulcanius Bangs, Bull. Mus. Comp. Zool., XXXIX, 1902, p. 38 (Volcan de Chiriqui, Panama).

Type locality.—Volcan de Irazu, Costa Rica.

Distribution.—Mountains of Costa Rica and western Panama.

Characters.—Similar to *R. dorsalis*, but slightly smaller, with smaller ears; tail less sharply bicolor; ochraceous colors slightly deeper and black dorsal band less clearly defined.

Color.—Upperparts ochraceous-buff, varying to pale orange-cinnamon, rather heavily mixed on back with black; median dorsal band usually very indistinct; underparts washed with light pinkish cinnamon; ears pale fuscous to fuscous-black; tail fuscous above, grayish white beneath; feet buffy white, shaded with hair-brown; wrists and ankles hair-brown.

Skull.—Slightly smaller than that of *dorsalis*, with flatter braincase; bullæ rather flat, averaging smaller than in *dorsalis;* ascending arms of premaxillæ projecting a little beyond end of nasals; upper molars simple, without accessory tubercles.

Measurements.—Type: Total length, 169 (160–179); tail vertebræ, 84.5 (82–92); hind foot, 18.5 (18–19). Skull: (See table, p. 81).

Remarks.—This species belongs in the *rufescens* group, being apparently the most southerly ranging member of the group and of the subgenus. It closely resembles *dorsalis* both in color and cranial characters, and additional material from Central America may make it necessary to unite the two as a single species.

The type of "*vulcanius*" from Panama has been examined and found to agree closely with topotypes of *australis* in the Biological Survey Collection.

Specimens examined.—Total number, 18, from the following localities:

Costa Rica: Volcan de Irazu, 17.
Panama: Volcan de Chiriqui, 1.[1]

REITHRODONTOMYS AUSTRALIS MODESTUS Thomas.

NICARAGUA HARVEST MOUSE.

Reithrodontomys modestus, Thomas, Ann. Mag. Nat. Hist., Ser. 7, XX, 1907, p. 163.

Type locality.—Jinotega, Nicaragua.

Distribution.—Known only from vicinity of type locality.

Characters.—Closely similar to *australis*, but underparts whiter and tail darker.

Color.—Upperparts mixed black and dull ochraceous-buff, with a fairly well-defined median band of blackish; underparts grayish white, rarely with a faint tinge of light ochraceous-buff and a pectoral spot of the latter color; tail distinctly bicolor, except at the tip, fuscous above, soiled whitish below; ears fuscous; hind feet grayish white; ankles dusky; front feet buffy, with a dusky stripe.

Skull.—Not seen. Apparently slightly smaller than that of *australis*, with smaller audital bullæ.

Measurements.—Type: "Head and body, 59; tail, 70; hind foot (s. u.), 16.5; ear, 12.5." Skull: (See table, p. 81).

Remarks.—This form appears to be very closely related to *australis*, but the material at hand is too scanty to show clearly its characters. The color description above is from specimens taken by Mr. William B. Richardson at San Rafael del Norte and kindly loaned by Dr. J. A. Allen of the American Museum of Natural History. These differ from Thomas's description of the type in having ochraceous instead of "drabby" sides and pectoral spot, and tail distinctly whiter beneath. The Richardson specimens are without complete skulls, so a study of the cranial characters has not been possible. Mr. W. H. Osgood, who compared the type specimen with material from the Biological Survey Collection, notes that its skull is slightly smaller than that of *australis*, the premaxillæ shorter, and the audital bullæ somewhat smaller.

Specimens examined:

Nicaragua: San Rafael del Norte, 8.[2]

Subgenus APORODON nobis.

Type.—*Reithrodontomys tenuirostris* Merriam.

Subgeneric characters.—Upper molars with subsidiary enamel loops in the outer primary reëntrant angles, these loops in most species reaching the outer border of the tooth and appearing, when viewed in profile, as prominent accessory tubercles; in other species (*chrysopsis* group) the enamel loops sometimes do not reach the outer border of the tooth and the accessory tubercles are often absent or much reduced.

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[1] Collection Mus. Comp. Zool.

[2] Collection Am. Mus. Nat. Hist.

Remarks.—The subgenus *Aporodon*, while not sharply set off from *Reithrodontomys* by any constant external characters, differs so widely in the molar pattern as described above that its segregation seems desirable.

It includes several well-marked groups, some of which possess striking characters, both cranial and external, while other species resemble the typical subgenus in all but the tooth characters.

The *tenuirostris-microdon* group (including also *creper*) and the *mexicanus* group (including *milleri*, *söderströmi*, and *gracilis*) show the greatest amount of differentiation from typical *Reithrodontomys*. These agree in having the outer wall of the anteorbital foramen relatively narrow (usually much narrower than width of interpterygoid fossa), broad interpterygoid fossa, short palatal foramina, unicolor tail, and dense pelage (rather woolly in most species) of a uniform tawny or ochraceous color, without pronounced darker grizzling. In all species in these groups the subsidiary enamel loops of the upper molars are well-developed and in unworn specimens appear as prominent tubercles.

The *chrysopsis* group approaches the typical subgenus in having the outer wall of anteorbital foramen broader, interpterygoid fossa narrower and palatal foramina longer. The subsidiary enamel loops of the upper molars are always well developed, but are usually (except in *perotensis*) not continuous to the outer edge of the tooth and the accessory tubercles are absent or much reduced. The pelage is long and full, and somewhat more silky than in *tenuirostris;* the upperparts are more or less varied with black, and the tail is bicolor.

R. levipes and *R. hirsutus* seem to be aberrant members of the subgenus, agreeing in the character of the pelage with the members of the typical subgenus, but having the subsidiary enamel loops of the upper molars well developed.

REITHRODONTOMYS LEVIPES GROUP.

REITHRODONTOMYS LEVIPES Merriam.

San Sebastian Harvest Mouse.

(Pl. III, fig. 2; Pl. VI, fig. 2; Pl. VII, figs. 3, 5.)

Reithrodontomys levipes Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 554.

Type locality.—San Sebastian, Jalisco, Mexico.

Distribution.—Known only from the type locality.

Characters.—About the size of *R. fulvescens toltecus;* color more decidedly tawny than any members of the *fulvescens* group; skull relatively short and broad.

Color.—Upperparts ochraceous-salmon, sparingly mixed on back with black; general tone of sides between ochraceous-salmon and ochraceous-orange; underparts strongly suffused with light pinkish cinnamon; fore and hind feet grayish white, sometimes tinged with the color of the sides; ears pale fuscous, with ochraceous hairs on inner surface; tail pale fuscous above, grayish white below. Compared with *toltecus*, the ochraceous color is more intense, there is much less darkening on the middle of the back, and the underparts are more intensely buffy.

Skull.—About the size of that of *R. f. toltecus* but shorter and broader; braincase rather flat; zygomata narrowed anteriorly; nasals short; ascending arms of premaxillæ extending about 1 mm. beyond end of nasals; audital bullæ very small; interpterygoid fossa broad; palatal foramina short and widely open. First and second upper molars with accessory enamel loops in primary reëntrant angles.

Measurements.—Average of 3 adults from type locality: Total length, 190 (188–192); tail vertebræ, 110.5 (110–111); hind foot, 20.8 (20.5–21). Skull: (See table, p. 81).

Remarks.—This species is remarkable not only for its peculiar characters but because of its (seemingly) restricted range. It resembles somewhat in color and character of pelage certain members of the *fulvescens* group, but its skull characters place it in the subgenus *Aporodon*. It seems to be most nearly related to the much larger *hirsutus*, known only from Ameca, Jalisco.

At the type locality of *levipes* occurs another much smaller species—*R. fulvescens tenuis*—a member of the typical subgenus. In the series referred to this species are three specimens which combine in a remarkable manner the characters of the two species. Externally they differ very little from *levipes* except in being somewhat less intensely ochraceous, both above and below, and in having rather shorter tails (103 and 104 mm.). Their skulls, however, are decidedly narrower than those of *levipes* and about intermediate in size between skulls of the latter and of *tenuis*. The upper molars have small accessory tubercles present in the principal angles, but the enamel pattern is practically the same as in *tenuis*. Another much smaller (adult) skull in the series shows a strong tendency to develop the accessory enamel loop characteristic of the subgenus *Aporodon*. This skull (No. 88056, U. S. Nat. Mus.) is smaller than those of typical *tenuis*. Anomalous as this situation may be, there seems to be no other explanation than that these specimens are hybrids between *levipes* and *tenuis*.

Specimens examined.—Three, from type locality.

REITHRODONTOMYS HIRSUTUS Merriam.

GIANT HARVEST MOUSE.

(Pl. III, fig. 1; Pl. VI, fig. 1.)

Reithrodontomys hirsutus Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 553.

Type locality.—Ameca, Jalisco, Mexico.

Distribution.—Known only from the type locality.

Characters.—Size very large; colors much as in *R. f. tenuis*, paler than in *R. levipes*.

Color.—Upperparts ochraceous-buff, brightest on sides, sparingly mixed on the back with blackish brown; underparts grayish white, usually with a distinct tinge of light buff; fore feet whitish, washed with light buff; hind feet grayish white, tinged with dusky; ankles fuscous; tail pale fuscous above, grayish white below; ears brownish drab.

Skull.—Large and robust with a well-defined supra-orbital bead which extends back to the parietals; braincase rather flat and somewhat narrowed posteriorly; zygomata contracted anteriorly; rostrum and nasals short; ascending arms of premaxillæ extending back of end of nasals; audital bullæ very small; palatal foramina short and wide; upper molars with subsidiary enamel loops.

Measurements.—Average of 5 adults from type locality: Total length, 211 (203–233); tail vertebræ, 127 (122–143); hind foot, 21.6 (21–22). Skull: (See table, p. 81).

Remarks.—This species is one of the largest in the genus, being exceeded in size of skull only by *R. tenuirostris*, a widely different species. So far as known, it has no near relative except *levipes*, and from that it differs both in size and color. It agrees with it, however, in every important cranial character—heavy rostrum, short and wide palatal foramina, broad interpterygoid fossa, and small bullæ.

In color, *hirsutus* bears a remarkable resemblance to *R. f. tenuis*, which inhabits the same region, but is hardly more than half the size of the present species.

Specimens examined.—Six, from type locality.

REITHRODONTOMYS CHRYSOPSIS GROUP.

REITHRODONTOMYS CHRYSOPSIS CHRYSOPSIS Merriam.

VOLCANO HARVEST MOUSE.

(Pl. III, fig. 3; Pl. VI, fig. 3; Pl. VII, fig. 6.)

Reithrodontomys chrysopsis Merriam, Proc. Biol. Soc. Wash., XIII, 1900, p. 152.

Type locality.—Mount Popocatepetl, Mexico (altitude 11,500 feet).

Distribution.—High mountains around the valley of Mexico; Mount Patamban and Mount Tancitaro in Michoacan. Altitudinal range from 9,000 feet to 13,500 feet (timber line).

Characters.—Size large (almost equaling *R. hirsutus*); tail long; pelage very long, soft, and silky; ears black or blackish; tail bicolor; skull with rounded and much inflated braincase; bullæ large.

Color.—Upperparts a rich shade of ochraceous, between ochraceous-buff and orange-buff, rather heavily mixed on back with black, the latter color usually forming an indistinct median band; general tone of sides near pinkish cinnamon; ears fuscous-black; tail sharply bicolor, fuscous above, grayish white beneath; feet grayish white; ankles fuscous; underparts strongly suffused with light pinkish cinnamon.

Skull.—Of large size (considerably exceeding that of *R. r. rufescens*); braincase subglobular, usually much inflated, sometimes moderately flattened; zygomata slender, strongly contracted anteriorly; outer wall of anteorbital foramen broad; rostrum slender, narrowing gradually to the tip; audital bullæ very large and moderately inflated; interpterygoid fossa relatively narrow (compared with *R. levipes*); palatal foramina long (as in *rufescens*); upper molars with subsidiary enamel loops in primary angles, but these usually not reaching outer border of tooth; accessory tubercles absent or much reduced.

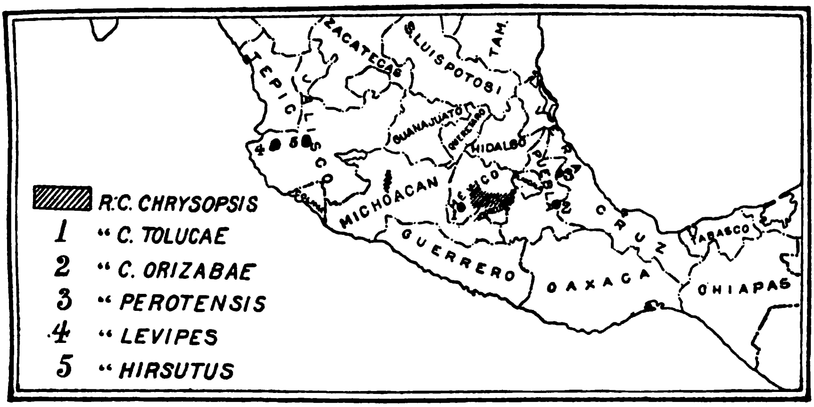

FIG. 5.—Distribution of *Reithrodontomys chrysopsis*, *R. perotensis*, *R. levipes*, *R. hirsutus*, and subspecies.

Measurements.—Type: Total length, 194; tail vertebræ, 108; hind foot, 21. Average of 5 specimens from Ajusco, Salazar, and Huitzilac: Total length, 185 (177–188); tail vertebræ, 106 (98–111); hind foot, 20.8 (20–21). Skull: (See table, p. 81).

Remarks.—This handsome and striking species is an inhabitant of the upper slopes of the mountains about the valley of Mexico and on more or less isolated mountains in western Michoacan. It is the first-described and best-known member of a subalpine group of species found on most of the higher mountains of southern Mexico and is apparently the only form having an extensive range. Specimens from Mount Tancitaro and Patamban show no characters to distinguish them from the typical form. From *R. f. toltecus*, which occupies the valley of Mexico, *chrysopsis* differs in larger size, richer colors, longer pelage, and blacker ears, as well as in cranial characters.

On Mount Popocatepetl, Nelson and Goldman found this species occurring sparingly in grassy places in the open forest from the base of the mountain up to 12,000 feet. On Mount Patamban it was most numerous at about 11,000 feet in the upper part of the Canadian Zone, a few ranging to the extreme summit above 12,000 feet. In the upper part of its range it was found among grass and brush.

Specimens examined.—Total number, 25, from the following localities in Mexico:

Mexico: Ajusco (11,000 feet), 3; Mount Iztaccihuatl (13,500 feet), 1; Mount Popocatepetl (11,500 feet), 3; Salazar (9,000 feet), 1.
Morelos: Huitzilac (10,000 feet), 1.
Michoacan: Mount Tancitaro (10,000–12,000 feet), 7; Patamban (11,000 feet), 9.

REITHRODONTOMYS CHRYSOPSIS TOLUCÆ Merriam.

TOLUCA HARVEST MOUSE.

Reithrodontomys chrysopsis tolucæ Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 549.

Type locality.—North slope of Volcan Toluca, Mexico (altitude, 11,500 feet).

Distribution.—Known only from the type locality.

Characters.—Similar to *chrysopsis*, but slightly smaller and much less intensely ochraceous; skull slenderer.

Color.—*Worn pelage:* Upperparts mixed black and ochraceous-tawny with a well-defined black median band, as in *chrysopsis*, but lacking almost entirely the bright golden color shown by the latter; ears fuscous; front feet buffy white, with a band of hair-brown reaching half way to the toes; hind feet soiled whitish, tinged with dusky; ankles fuscous; ring around eye blackish; underparts grayish with scarcely a trace of buff; tail hair-brown above, grayish white below.

Skull.—Slightly smaller than that of *chrysopsis;* braincase narrower; rostrum slenderer, much narrowed at the tip; bullæ much smaller; subsidiary enamel loops of upper molars low and slightly developed; accessory tubercles absent.

Measurements.—Type: Total length, 180; tail vertebræ, 98; hind foot, 21. Skull: (See table, p. 81).

Remarks.—This form, known from only a single specimen, has rather pronounced characters. On account of the worn condition of the type specimen, the colors can not be satisfactorily described. Specimens in fresh pelage will doubtless prove less different from *chrysopsis* than is this worn individual, but the underparts apparently are distinctly whiter.

Specimen examined.—One, the type.

REITHRODONTOMYS CHRYSOPSIS ORIZABÆ Merriam.

MOUNT ORIZABA HARVEST MOUSE.

Reithrodontomys orizabæ Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 550.

Type locality.—Mount Orizaba, Puebla, Mexico (altitude, 9,500 feet).

Distribution.—Known only from the type locality.

Characters.—Externally the same as *chrysopsis*; skull narrower and bullæ smaller.

Color.—As in *chrysopsis*.

Skull.[1]—Apparently smaller than that of *chrysopsis*, but length of skull and shape of zygomata not known; braincase narrower, audital bullæ decidly smaller; molar series and nasals shorter; subsidiary enamel loops of m^2 well developed, of m^1 present but shorter. Compared with *tolucæ:* Braincase and bullæ similar; rostrum broader.

Measurements.—Type: Total length, 182; tail vertebræ, 105; hind foot, 20. Skull: (See table, p. 81).

Remarks.—This form so closely resembles *chrysopsis* in color that it seems best to consider it a subspecies of the latter; in cranial characters it more nearly resembles *tolucæ*. Additional material is necessary to determine its true relationship.

Specimen examined.—One, the type.

REITHRODONTOMYS PEROTENSIS Merriam.

PEROTE HARVEST MOUSE.

Reithrodontomys perotensis Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 550.

Type locality.—Cofre de Perote, Vera Cruz, Mexico (altitude, 9,500 feet).

Distribution.—Known only from the type locality.

Characters.—Externally similar to *chrysopsis*, but color of upperparts less intensely ochraceous; skull smaller with much smaller bullæ.

Color.—Upperparts cinnamon with strong tinge of ochraceous, extensively mixed with black and with a distinct median band of the latter color; ears fuscous, somewhat paler than in *chrysopsis;* underparts strongly washed with light pinkish cinnamon; tail pale fuscous above, slightly whitened beneath.

Skull.—Smaller than that of *R. c. chrysopsis*, with flatter braincase and smaller bullæ; zygomata squarely spreading anteriorly, nearly parallel to axis of skull; subsidiary enamel loops in upper molars well developed, reaching outer border of tooth.

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[1] The type and only known specimen is badly broken.

Measurements.—Type: Total length, 176; tail vertebræ, 119; hind foot, 19. Skull: (See table, p. 81).

Remarks.—This species differs widely in cranial characters from the other members of the *chrysopsis* group. Indeed, its skull somewhat resembles that of *R. megalotis saturatus* (which occupies the low country around the base of the Cofre de Perote), especially in the widely spreading zygomata and in the shape and size of the audital bullæ. It differs from *saturatus*, however, in having a much broader and flatter braincase, longer and slenderer rostrum, buffy instead of white underparts, and in dental characters.

Specimen examined.—One, the type.

REITHRODONTOMYS MEXICANUS GROUP.

REITHRODONTOMYS MEXICANUS MEXICANUS (De Saussure).

SAUSSURE HARVEST MOUSE.

(Pl. III, fig. 4; Pl. VI, fig. 4; Pl. VII, figs. 4, 9, 10, 11.)

Reithrodon mexicanus De Saussure, Rev. Mag. Zool., 2d ser., XII, 1860, p. 109.
Ochetodon mexicanus Coues, Proc. Acad. Nat. Sci. Phila., 1874, p. 186.
Reithrodontomys costaricensis jalapæ Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 552 (Jalapa, Vera Cruz).
Reithrodontomys cherriei jalapæ Miller, Bull. 79, U. S. Nat. Mus., 1912, p. 130.

Type locality.—Mountains of Vera Cruz, Mexico.

Distribution.—From Jalapa, Vera Cruz, south to Chiapas and Guatemala.

Characters.—Size rather large (about like *R. f. toltecus*); tail long, concolor; color uniform tawny above, white below; hind feet, ears and tail dark; skull short, broad, and flat.

Color.—Upperparts varying from tawny to pinkish cinnamon, sparingly darkened on the back with blackish hairs; general tone of back varying from cinnamon-brown to Prout's brown; an indistinct blackish ring around eye; tail nearly unicolor, fuscous or clove-brown to fuscous-black, in some specimens slightly paler beneath; upper surfaces of both fore and hind feet dark hair-brown; toes usually buffy or grayish white; ears fuscous or fuscous-black; sides of nose, upper lips, and underparts white.

Skull.—Short and relatively broad, with very short, broad rostrum and short nasals; braincase squarish, rather flat, depressed posteriorly; zygomata slender, contracted anteriorly; nasals ending behind rather squarely, on a line with ends of premaxillæ or slightly anterior to them; outer wall of anteorbital foramen narrow; interpterygoid fossa broad; palatal foramina short, ending at or slightly in front of plane of first molars; audital bullæ small.

Measurements.—Adult male (Jalapa, Vera Cruz): Total length, 197; tail vertebræ, 119; hind foot, 21. Average of 2 adults from Totontepec, Oaxaca: 193; 117; 21. Average of 3 adults from Jacaltenango, Guatemala, and Tumbala, Chiapas: 194; 117; 20.2. Skull: (See table, p. 81).

Remarks.—This species, although described over 50 years ago, is still imperfectly known, and the name *mexicanus* has been misapplied by all authors since De Saussure. Three distinct species of *Reithrodontomys* occur in the mountains of Vera Cruz and a fourth (*R. megalotis saturatus*) not far away on the table-land. These (using the modern names) are *R. rufescens rufescens*, *R. fulvescens difficilis*, and *R. "cherrii jalapæ."*[1]

The original description[2] is so complete and agrees so perfectly with the last of these that there appears to be not the slightest doubt that the species now known as "*jalapæ*" should be referred to *mexicanus*. The combination of tawny upperparts, white belly, dark feet, and unicolor tail is possessed by no other species in this region.

Through the kindness of M. Maurice Bedot, director of the Geneva Museum, who has furnished the Biological Survey with photographs and measurements of the type skull, I am able to present additional evidence corroborative of the above decision. The photographs clearly show the relatively narrow outer wall of the anteorbital foramen and the broad interpterygoid fossa, characteristic of the subgenus *Aporodon*, and the measurements agree closely with those of specimens of "*jalapæ*" from Jalapa, Vera Cruz.

The type of *R. mexicanus*, with the skull inside the skin, was borrowed in 1890 from the Geneva Museum and examined in Washington by Drs. Allen, Merriam, and True. Comparison was made with a specimen[3] (No. 7007a, U.S. Nat. Mus.) from Tehuacan, Puebla, at that time practically the only available specimen from southern Mexico. Dr. Allen in referring this specimen to *mexicanus* stated that it agreed with the type.[4] Dr. Merriam's notes, however, taken at the same time, indicate some important differences. These are as follows:

No. $\frac{418}{100}$. This specimen is the type of De Saussure's description. *Measurements.*—Hind foot, 18.5. Ear from crown, 10; from anterior base, 13. The upper-

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[1] All of these have been taken at Jalapa, Vera Cruz.

[2] Following is a translation of the pertinent portions:

"The size of this animal is nearly exactly that of the European field-mouse (*Mus silvaticus*), though its forms are somewhat more thick set. * * * Tail very long, its length exceeding that of the body and head. The color of the pelage is tawny brown, on the sides becoming absolutely tawny, or even orange-tawny. The tawny color becomes fainter toward the line where it comes in contact with the white of the belly. The lips, lower part of cheeks, chin, throat, and entire underparts are almost pure white, here and there slightly washed with a tawny tint, especially on the breast and throat. * * * The hairs are slate gray, the tips only passing into russet, or white. The ears are brown * * *. The fore feet are white, except above, as far as the root of the digits, where they are gray. The tail is blackish, scaly, unicolor, and covered with rather dark gray hairs; it is especially hairy toward the tip; at its base the hairs are scanty and very short; but they become longer toward the tip."

[3] Referred by the writer to *R. fulvescens difficilis*.

[4] Bull. Am. Mus. Nat. Hist., VII, 1895, p. 136.

> parts are so thoroughly suffused with fulvous that it can almost be called a "red mouse." The upper surface of the hind foot is dark brown to base of toes. The toes are whitish. The skull has never been removed from the skin. There is a skin of this species or a closely related subspecies in the United States National Museum (No. 7007a) collected at Tehuacan, Puebla, Mexico, by Sumichrast. Upperparts rusty fulvous, but not quite so deep or bright as in the mounted specimen [the type]. The only departure of importance from the type is the color of the upper surface of the hind foot, which is soiled whitish instead of dark brown, and the color of the underside of the tail, which is whitish instead of being concolor with the upper surface.

These differences—whiter feet and bicolor tail—are sufficient to show that the Tehuacan specimen can not be referred to *mexicanus*. No mention is made, either by Allen or Merriam, of the color of the underparts, but taking into consideration the soiled and faded condition of the Tehuacan specimen (and probably, also, of the type) this omission is not strange.

On the evidence of this determination the name *mexicanus* was used by Allen for the dark form of the *fulvescens* group later described from Orizaba by Merriam as *R. difficilis*, but, as shown above, it properly applies to the species now under consideration—a member of the subgenus *Aporodon*.

The species exhibits considerable individual variation in color. One specimen from Totontepec, Oaxaca, is fairly typical, while another from the same place is considerably darker, with darker ears and tail. A specimen from Jacaltenango, Guatemala, is considerably paler than Vera Cruz specimens, but agrees with them in other characters.

Intergradation with *goldmani* on the north and with *cherrii* in Central America seems fairly certain to be established.

Specimens examined.—Total number, 10, from the following localities in Mexico and Guatemala:

Vera Cruz: Jalapa, 2.[1]
Oaxaca: Totontepec, 2.
Chiapas: Comitan, 1; Tenejapa, 1; Tumbala, 3.
Guatemala: Jacaltenango, 1.

REITHRODONTOMYS MEXICANUS GOLDMANI Merriam.

GOLDMAN HARVEST MOUSE.

(Pl. III, fig. 6; Pl. VI, fig. 6.)

Reithrodontomys goldmani Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 552.

Type locality.—Metlaltoyuca, Puebla, Mexico (altitude 800 feet).

Distribution.—Known only from northern Puebla.

Characters.—Similar to *mexicanus*, but smaller and paler.

Color.—Upperparts pinkish cinnamon, faintly darkened on top of head and back with brownish hairs; general tone of back about snuff-brown; sides of nose, upper lips, and underparts white, the latter with a faint tinge of pale buff; ears dark hair-brown; tail fuscous, nearly unicolor or slightly paler beneath; fore and hind feet grayish white, tinged with dusky; ankles hair-brown.

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[1] One in Collection Am. Mus. Nat. Hist.

Skull.—Longer and relatively narrower than that of *mexicanus;* braincase flattened, and narrowed posteriorly; rostrum and nasals longer, the latter narrowed to a point posteriorly; audital bullæ slightly larger; palatal foramina wide.

Measurements.—Type: Total length, 190; tail vertebræ, 109; hind foot, 21.5. Skull: (See table, p. 81).

Remarks.—This subspecies is the most northerly ranging member of the group. It occupies the low, arid, coast region of northern Puebla and probably adjacent States. It is distinctly paler than *mexicanus* and the skull of the type shows pronounced characters, some of which, however, may not prove to be constant. Two specimens from Huauchinango, Puebla (altitude 5,000 feet) are intermediate between *goldmani* and *mexicanus*, the skulls being nearer to the latter form, the skins nearer *goldmani*.

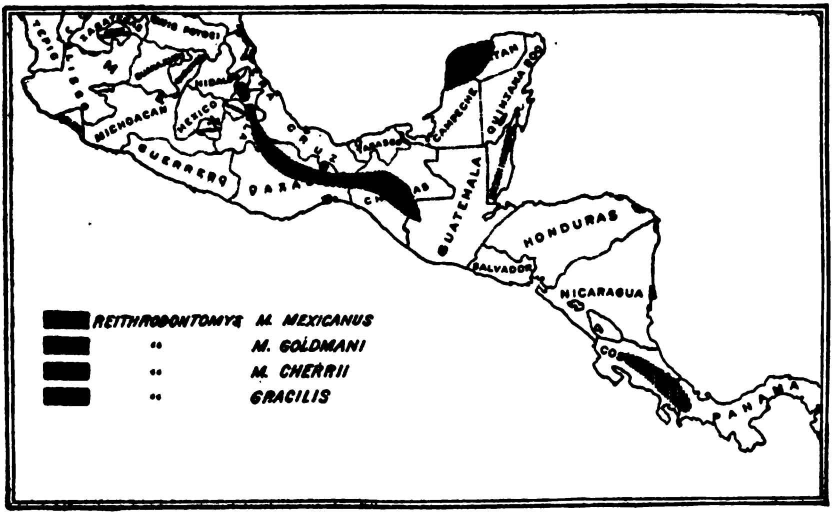

FIG. 6.—Distribution of *Reithrodontomys mexicanus*, *R. gracilis*, and subspecies.

Specimens examined.—Total number, 3, from the following localities in Mexico:

Puebla: Huauchinango, 2; Metlaltoyuca, 1.

REITHRODONTOMYS MEXICANUS CHERRII (Allen).

CENTRAL AMERICAN HARVEST MOUSE.

(Pl. III, fig. 5; Pl. VI, fig. 5.)

Hesperomys (*Vesperimus*) *cherrii* Allen, Bull. Am. Mus. Nat. Hist., III, 1891, p. 211.
Sitomys cherriei Allen, Ibid., V, 1893, p. 238.
Reithrodontomys costaricensis Allen, Ibid., VII, 1895, p. 139 (La Carpintera, Costa Rica).
Reithrodontomys cherriei Osgood, Proc. Biol. Soc. Wash., XX, 1907, p. 50 (type fixed).

Type locality.—San Jose, Costa Rica.

Distribution.—Costa Rica and Chiriqui, Panama.

Characters.—Similar to *mexicanus*, but colors brighter (more tawny, less blackish); ears paler; skull larger.

Color.—Upperparts varying from bright tawny to hazel, more or less mixed with black on dorsal area; ears dusky hair-brown, scantily haired; underparts white (rarely washed with yellowish buff); tail fuscous, unicolor, clothed with short, bristly hairs; fore and hind feet pale sepia, broadly edged with whitish; toes buffy white.

Skull.—Larger than that of *mexicanus*, with longer rostrum; braincase more inflated.

Measurements.—Average of 7 adults from Costa Rica (San Pedro and La Carpintera): Total length, 191 (182–198); tail vertebræ, 111 (103–123); hind foot, 20 (19.5–20.5). Average of 13 adults from Boquete, Chiriqui: Total length, 207 (192–227); tail vertebræ, 126 (115–140); hind foot, 20 (19–22). Skull: (See table, p. 81).

Remarks.—Through an unfortunate mixing of skulls this species was originally described as a *Hesperomys* [=*Peromyscus*] and a few years later, before the mistake was discovered, redescribed as *Reithrodontomys* "*costaricensis*," by which name it has usually been known. Osgood has shown the pertinence of the original description to the present species and has selected a type specimen from the original series.[1]

The species is one of the larger members of the genus, though not so large as *R. t. tenuirostris* and *R. hirsutus*. Intergradation with *mexicanus* seems probable, though not perfectly shown by the material at hand. A specimen from Jacaltenango, Guatemala, is somewhat intermediate in characters, but apparently nearest to *mexicanus*. Specimens from Boquete, Chiriqui, have somewhat longer tails than the series from Costa Rica. A single specimen from Nicaragua is much less tawny than the type series, somewhat resembling the Guatemala specimen.

Specimens examined.—Total number, 21, from the following localities:

Costa Rica: La Carpintera, 3;[2] San Jose, 2;[3] San Pedro, 3.[2]
Panama: Boquete, Chiriqui, 13.[3]

REITHRODONTOMYS MILLERI Allen.

Colombian Harvest Mouse.

Reithrodontomys milleri Allen, Bull. Am. Mus. Nat. Hist., XXXI, 1912, p. 77.

Type locality.—Munchique, Cauca, Colombia (altitude, 8,325 feet).

Distribution.—Known only from Colombia (altitude 6,000 to 10,300 feet).

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[1] Proc. Biol. Soc. Wash. XX, 1907, p. 50.

[2] Collection Am. Mus. Nat. Hist.

[3] Eleven in Collection Mus. Comp. Zool.

Characters.—Paler and less tawny than *R. m. cherrii;* tail shorter.

Color.—Upperparts varying from light ochraceous-salmon, extensively mixed with brownish to nearly pure tawny, with slight admixture of brown; lateral line only faintly indicated; underparts white, sometimes with a faint tinge of light buff; ears and tail dark hair-brown, the latter almost unicolor, but slightly paler beneath; feet hair-brown, sometimes edged with grayish white.

Skull.—Very similar to that of *R. m. cherrii*, with short, heavy rostrum, broad frontals, and short palatal foramina.

Measurements.—Ten adults: Total length, 181 (169–190); tail vertebræ, 107 (98–116); hind foot, 19 (18–20). Skull: (See table, p. 81).

Remarks.—This species is rather closely related to *R. m. cherrii*, from which it differs in browner, less tawny coloration and shorter tail. No intermediate specimens are known, but further collecting in Panama may result in securing such.

Specimens examined.—Total number, 7, from the following localities:[1]

Colombia: Cocal, 1; El Roble (7,000 feet), 5; La Guneta, 1; Munchique, 5; San Augustin, Huila (10,300 feet), 1.

REITHRODONTOMYS SÖDERSTRÖMI Thomas.

ECUADOR HARVEST MOUSE.

Reithrodontomys söderströmi Thomas, Ann. Mag. Nat. Hist., ser. 7, I, 1898, p. 451.

Type locality.—Quito, Ecuador.

Distribution.—Known only from the type locality and from Valle de las Papas, southern Colombia.

Characters.—Apparently in the *cherrii* group and closely related to *milleri;* colors less tawny above and more buffy or fawn-colored below; hind foot, ear, and skull larger.

Color.—"Dull grayish fawn, not nearly so rufous as in *costaricensis* [*cherrii*]. Brighter lateral line little developed. Under surface not sharply defined, its color much less bright than in *costaricensis*, the tips of the hairs more or less buffy or fawn-colored. Ears thinly haired, brown, little darker than the general color. Hands and feet white, without darker markings on the metapodials. Tail pale brown above and below, the tip white."[2] A series of 4 specimens from Valle de las Papas, central Andes, Huila, Colombia,[3] may be described as follows: Upperparts mixed blackish brown and ochraceous-salmon; ears clove-brown; tail dark mummy-brown; hind feet soiled whitish, with a broad band of mummy-brown reaching nearly to the toes;

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[1] All in Collection Am. Mus. Nat. Hist.

[2] Thomas, loc. cit.

[3] Compared by Dr. J. A. Allen and Mr. Oldfield Thomas with the type and 12 topotypes in the British Museum and said to agree perfectly with them.

front feet similar, but with less brown; underparts white, strongly tinged with pale ochraceous-salmon. With regard to the color of the hind feet in the typical series, Mr. Thomas writes me as follows:

> Of 20 specimens, 12 have large metapodial patches [of brown], 7 have smaller ones down to quite minute ones (often not the same on both sides) and the type has practically none at all—though even there a few hairs are dark on each foot, making a minute spot.

Skull.—Similar to that of *milleri*, but larger. "Low, with a flat superior profile. Palatal foramina short, barely reaching backward to the level of the front of m^1."[1] More recently Mr. Thomas has compared the topotype series with specimens of *R. m. cherrii* and states:[2] "I can find no skull difference of any importance or constancy."

Measurements.—Type (from dry skin): "Head and body, 72; tail (tip doubtfully perfect), 83; hind foot (wet) without claws, 19; ear (wet), 14. Skull: Back of parietal to nasal tip, 21.1; greatest breadth, 11.5; nasals 8.9 x 2.6; interorbital breadth, 3.7; palate from henselion, 9.2; diastema, 5.9; palatal foramina, 4.1 x 1.6; upper molar series, 3.8."[3] Skull of fully adult topotype (measured by Mr. Thomas): Greatest length 24.2; breadth of braincase, 11.5; length of nasals, 9.1; width of outer wall of anteorbital foramen, 1.9.

Remarks.—This species, so far as known, is the most southerly ranging member of the genus. I have not been able to examine the type series of 20 specimens in the British Museum, but I have seen a small series from southern Colombia, kindly loaned by Dr. Allen, and which both he and Mr. Thomas consider typical of this species. From an examination of this series it is clear that *söderströmi* is a member of the *mexicanus* group and rather closely related to *milleri*, but whether it is connected with the latter by intermediate forms can not at present be determined.

Its habits are described by Mr. L. Söderström, the collector of the type series, as follows: "Feeds on flowers and seeds in the gardens. Comes out from among the climbing plants every evening at about 7 p. m."

Specimens examined.—Four, from Valle de las Papas, Huila, Colombia (central Andes, altitude 10,000 feet).[4]

REITHRODONTOMYS GRACILIS Allen & Chapman.

YUCATAN HARVEST MOUSE.

(Pl. III, fig. 7; Pl. VI, fig. 7.)

Reithrodontomys mexicanus gracilis Allen and Chapman, Bull. Am. Mus. Nat. Hist., IX, 1897, p. 9.

Type locality.—Chichen Itza, Yucatan, Mexico.

Distribution.—Yucatan and Campeche.

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[1] Original description by Thomas.

[2] In epistle, Oct. 21, 1913.

[3] Thomas, loc. cit.

[4] Collection Am. Mus. Nat. Hist.

Characters.—Size small; similar in color to *R. m. goldmani*, but brighter; skull much smaller with narrow braincase.

Color.—Upperparts pinkish cinnamon, sparingly lined on dorsal surface with blackish brown; color brightest on sides next to the belly, sometimes forming an indistinct lateral line (as in the *fulvescens* group); ears dark hair-brown; tail fuscous, slightly paler beneath; fore feet buffy white; hind feet grayish white; ankles fuscous; underparts white, sometimes with a slight yellowish cast; less white on sides of nose than in *mexicanus* and *goldmani.*

Skull.—Decidedly smaller than that of either *mexicanus* or *goldmani;* similar in size and general proportions to that of *difficilis*, but differing in the characters of the subgenus; rostrum short and broad; braincase narrow and moderately flat; nasals short; zygomata nearly parallel to axis of skull (much less contracted anteriorly than in *mexicanus*); palatal foramina very short; bullæ rather small.

The outer wall of the anteorbital foramen, although much narrower than in skulls of *R. fulvescens difficilis*, is relatively broader than in the other members of the subgenus and may slightly exceed the width of the interpterygoid fossa. The subsidiary enamel loops are present on the upper molars, but the accessory tubercles are rather low.

Measurements.—Type (immature): Total length, 165; tail vertebræ, 98; hind foot, 16. Average of 2 topotypes (immature): 169; 100; 18. A somewhat older (subadult) specimen from Yohaltun, Campeche: 191; 113; 20. Skull: (See table, p. 81).

Remarks.—This is the smallest member of the *mexicanus* group. Externally it bears a striking resemblance to *R. fulvescens tenuis*, differing chiefly in darker and more nearly unicolor tail and more uniform ochraceous color (less grizzled with black) on the upperparts. In skull characters the two differ widely, *gracilis* clearly belonging in the subgenus *Aporodon.*

From *R. m. mexicanus*, its nearest relative, it differs in much smaller size, paler coloration, and narrower skull. Judging from the very limited material at hand, it seems to be specifically distinct from the other members of the group. One specimen from Yohaltun, Campeche, differs from the type series in being somewhat darker, with blacker, more nearly unicolor tail.

Specimens examined.—Total number, 9, from the following localities in Mexico:

Yucatan: Chichen Itza, 6;[1] Progreso, 1.
Campeche: Apazote, 1; Yohaltun, 1.

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[1] Four in Collection Am. Mus. Nat. Hist.

REITHRODONTOMYS TENUIROSTRIS GROUP.

REITHRODONTOMYS TENUIROSTRIS TENUIROSTRIS Merriam.

WOOLY HARVEST MOUSE.

Reithrodontomys tenuirostris Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 547.

Type locality.—Todos Santos, Guatemala (altitude 10,000 feet).

Distribution.—Known only from the type locality.

Characters.—Size very large (equaling *R. hirsutus*, except in length of tail); pelage long, soft, and wooly; color rich tawny; tail unicolor; skull with much swollen braincase and narrow rostrum.

Color.—*Adults:* Upperparts deep tawny, darkest on the dorsal area where the color becomes hazel; an indistinct blackish ring around eye; underparts light pinkish cinnamon; ears and tail fuscous; ankles and hind feet clove-brown; tips of toes whitish; upper surface of fore feet hair-brown; toes buffy. *Young:* Upperparts Prout's brown, with a tinge of tawny; underparts paler than in the adult; toes buffy white.

Skull.—Braincase broad, much inflated, depressed posteriorly; anterior portion of frontals abruptly depressed, forming a shallow sulcus at posterior end of nasals; rostrum long and narrow; nasals narrowed to a point posteriorly, ending on a line with premaxillæ; zygomata slender, slightly contracted anteriorly; palatal foramina relatively short, not reaching plane of first molars; interpterygoid fossa broad (about as wide as outer wall of anteorbital foramen); bullæ small and rather flat.

Measurements.—Type (♂ ad.): Total length, 210; tail vertebræ, 124; hind foot, 23. Skull: (See table, p. 81).

Remarks.—This is one of the largest and most striking members of the genus. Resembling *R. m. mexicanus* in the color of the upperparts, it is readily distinguished by its cinnamon belly. Its skull is so peculiar that it is placed in a different group from the latter.

Specimens examined.—Two, from type locality.

REITHRODONTOMYS TENUIROSTRIS AUREUS Merriam.

CALEL HARVEST MOUSE.

(Pl. III, fig. 8; Pl. VI, fig. 8; Pl. VII, fig. 2.)

Reithrodontomys tenuirostris aureus Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 548.

Type locality.—Calel, Guatemala (altitude 10,200 feet).

Distribution.—Known only from the type locality.

Characters.—Slightly smaller and paler than *tenuirostris*.

Color.—*Adults:* Upperparts ochraceous-tawny moderately darkened on dorsal area with black; underparts light ochraceous-buff (a little yellower than in *tenuirostris*); ears fuscous-black; tail fuscous, slightly paler beneath; fore feet dark hair-brown; hind feet clove-brown, both edged with white; toes whitish. *Young:* Upperparts Prout's brown, faintly tinged with ochraceous; underparts white.

Skull.—Slightly smaller than that of *tenuirostris*, with flatter braincase and more inflated bullæ; palatal foramina longer and slightly broader, extending behind plane of first molars.

Measurements.—Adult female: Total length, 196; tail vertebræ, 112 hind foot, 22.5. Skull: (See table, p. 81).

Remarks.—This subspecies lives at about the same altitude as does *tenuirostris* and only a short distance away. With the very limited amount of material at hand, it is impossible to say whether the characters distinguishing the two forms will prove to be constant.

Specimens examined.—Two, from type locality.

REITHRODONTOMYS CREPER Bangs.

CHIRIQUI HARVEST MOUSE.

Reithrodontomys creper Bangs, Bull. Mus. Comp. Zool., XXXIX, 1902, p. 39.

Type locality.—Volcan de Chiriqui, Panama (altitude, 11,000 feet).

Distribution.—Known only from the type locality.

Characters.—Size large; colors very dark (similar to *R. a. australis* above, but darker beneath); skull similar to that of *R. t. tenuirostris*, but smaller.

Color.[1]—Type: Upperparts mummy-brown, varying on sides to Mars brown; sides of face blackish; underparts russet; ears dark sepia; tail dusky—almost clove-brown—all around, except terminal fourth which is whitish; feet whitish, palest on toes.

Skull.—Similar in shape to that of *R. t. tenuirostris*, but smaller; braincase narrowed posteriorly; palatal foramina expanded in the middle, narrowing anteriorly; zygomata much contracted anteriorly. Compared with *R. t. aureus:* Skull slightly shorter and much narrower; bullæ smaller.

Measurements.—Type (♀ ad.): Total length, 215; tail vertebræ, 130; hind foot, 23. Skull: (See table, p. 81).

Remarks.—This very distinct species is known only from a single specimen, "caught on the cold barren summit of the Volcan de Chiriqui".[2] It seems to be nearest related to *R. tenuirostris*, from Guatemala.

Specimen examined.—One, the type.[3]

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[1] Comparisons with Ridgway's "Nomenclature of Colors" (1886).

[2] Bangs, loc. cit.

[3] Collection Mus. Comp. Zool.

REITHRODONTOMYS MICRODON MICRODON Merriam.

SMALL-TOOTHED HARVEST MOUSE.

(Pl. III, fig. 9; Pl. VI, fig. 9.)

Reithrodontomys microdon Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 548.

Type locality.—Todos Santos, Guatemala.

Distribution.—Highlands of Guatemala; limits unknown.

Characters.—Closely similar in color to *R. t. tenuirostris*, but very much smaller.

Color.—*Adults:* Upperparts tawny, brighter on the sides next to the belly, darkened on back and head with black, where the tone becomes hazel; blackish ring around eye; underparts light pinkish cinnamon; ears and tail fuscous, the latter slightly paler beneath; hind feet dark hair-brown edged with whitish; toes white; fore feet buffy white with a patch of dusky. *Subadults:* Upperparts browner (about Prout's brown) and less mixed with tawny; underparts white.

Skull.—Similar in general shape to that of *R. t. tenuirostris*, but very much smaller; braincase moderately inflated, narrowed and depressed posteriorly; zygomata slender, decidedly contracted anteriorly; rostrum narrow; palatal foramina ending on plane of front molars; interpterygoid fossa very broad; bullæ rather large and inflated; outer wall of anteorbital foramen very narrow.

Measurements.—Type (♀ ad.): Total length, 185; tail vertebræ, 113; hind foot, 21. Topotype (♂ subadult): 180; 112; 21. Skull: (See table, p. 81).

Remarks.—This little species is in every way a miniature of the large *tenuirostris*, which lives in the same region.

Specimens examined.—Total number, 3, from the following localities:

Guatemala: Todos Santos, 2; Volcan Santa Maria 1.

REITHRODONTOMYS MICRODON ALBILABRIS Merriam.

WHITE-LIPPED HARVEST MOUSE.

Reithrodontomys microdon albilabris Merriam, Proc. Wash. Acad. Sci., III, 1901, p. 549.

Type locality.—Cerro San Felipe, Oaxaca, Mexico (altitude, 10,000 feet).

Distribution.—Known only from the type locality.

Characters.—Similar to *microdon*, but paler; underparts white; closely similar in color to *R. mexicanus goldmani*.

Color.—Upperparts pinkish cinnamon, darkened on dorsal area with black, where the tone becomes snuff-brown; blackish ring around eye; ears, tail, and hind feet fuscous, the last edged with whitish; toes whitish; fore feet buffy, with a dusky patch; underparts white.

Skull.—Very similar to that of *microdon;* braincase slightly broader and more inflated; interpterygoid fossa narrower; bullæ slightly smaller; nasals ending on a line with premaxillæ; zygomata decidedly contracted anteriorly; palatal foramina short, not reaching plane of molars.

Measurements.—Type (♀ ad.): Total length, 187; tail vertebræ, 117; hind foot, 20. Skull: (See table below).

Remarks.—This form is closely related to *microdon*, differing chiefly in paler coloration.

Specimen examined.—One, the type.

Average cranial measurements of Reithrodontomys.

Species.	Number averaged.	Localities.	Greatest length.	Breadth of brain-case.	Length of nasals.	Width of outer wall of antorbital foramen.
R. humulis humulis	8	North Carolina; South Carolina; Georgia	19.4	9.3	6.4	1.9
R. humulis impiger	4	West Virginia: White Sulphur Springs	19.4	9.2	6.4	1.7
R. humulis merriami	6	Texas: Austin Bayou; Louisiana: Lafayette.	19	9.3	6.9	2.1
R. albescens albescens	5	Nebraska; South Dakota	19.5	9.6	7.3	2.2
R. albescens griseus	4	Texas: San Antonio, San Angelo	19.3	9.3	7.2	1.9
R. montanus	4	Colorado: San Luis Valley	20	9.4	7.9	2.1
R. megalotis megalotis	6	New Mexico (southern); Chihuahua	20.7	9.9	7.5	2.1
R. megalotis aztecus	4	New Mexico: La Plata, Aztec, Guadalupita.	22.1	10.5	8.5	2.2
R. megalotis dychei	11	Kansas: Lawrence, Onaga	20.6	10.1	7.8	2.1
R. megalotis nigrescens	6	Idaho: Payette, Weiser, Nampa	20.8	9.9	8	1.9
R. megalotis longicaudus	12	California: Vicinity of San Francisco Bay	20.2	9.8	7.7	2
R. megalotis peninsulæ	4	Lower California: San Quintin, Rosario	20.7	10.2	8.1	1.9
R. megalotis cinereus	4	Puebla: Chalchicomula	21.6	10.3	8.2	2.2
R. megalotis saturatus	8	Vera Cruz: Las Vigas	22.5	10.4	8.7	2.2
R. megalotis alticolus	1	Oaxaca: Cerro San Felipe	22.4	10.5	8.5	2.3
R. megalotis arizonensis	2	Arizona: Chiricahua Mountains	20.4	9.9	7.5	1.9
R. megalotis zacatecæ	3	Zacatecas: Valparaiso Mountains	20.5	9.9	8.2	1.9
R. amoles	1	Queretaro: Pinal de Amoles	19.8	9.5	7.6	1.7
R. catalinæ	5	California: Catalina Island	21.9	10.3	8.8	2.3
R. raviventris raviventris	6	California: San Francisco Bay	21.2	10.2	7.6	2.1
R. raviventris halicœtes	7	California: Petaluma (marshes)	20.8	10.1	7.5	2
R. fulvescens fulvescens	3	Sonora: Oposura, Providencia Mines	21.6	10.3	8.2	2
R. fulvescens tenuis	6	Sinaloa: Mazatlan, Sinaloa, Escuinapa	21.9	10.2	8.3	2
R. fulvescens intermedius	6	Texas: Brownsville; Tamaulipas	21.9	10.3	8.5	2
R. fulvescens aurantius	7	Texas and Louisiana	22.2	10.5	8.5	2.2
R. fulvescens difficilis	6	Vera Cruz: Orizaba, Jalapa	21.8	10.5	7.8	1.9
R. fulvescens toltecus	2	Mexico: Tlalpam, D. F	23.4	10.7	9.4	2.1
R. fulvescens helvolus	7	Oaxaca: Oaxaca	22.4	10.6	8.5	2.1
R. fulvescens chiapensis	4	Chiapas: Canjob	22.4	10.7	8.1	2
R. fulvescens nelsoni	4	Colima: Colima	21.2	10	8	1.8
R. fulvescens mustelinus	1	Oaxaca: Llano Grande	22.3	10.4	9	2.2
R. amœnus	2	Oaxaca: Reforma	19.5	10.3	7.7	1.8
R. otus	1	Jalisco: Sierra Nevada de Colima	23.8	11	9.3	2.1
R. rufescens rufescens	8	Vera Cruz: Jalapa, Jico	23.6	10.9	9	2.1
R. rufescens luteolus	3	Oaxaca: Juquila	23.9	11.1	9.1	2.2
R. alleni	1	Oaxaca: Mountains near Ozolotepec	......	......	9	2.1
R. colimæ colimæ	1	Jalisco: Sierra Nevada de Colima	23.2	11.3	10.1	1.9
R. colimæ nerterus	1	.....do	22.6	11	8.4	2.2
R. dorsalis	4	Guatemala: Calel	23	10.6	9	2.1
R. australis australis	5	Costa Rica: Volcan Irazu	22.5	10.7	8.2	1.8
R. australis modestus	1	Nicaragua: Jinotega	21	10.5	7.8	1.8
R. levipes	3	Jalisco: San Sebastian	22.7	11.4	7.9	1.9
R. hirsutus	4	Jalisco: Ameca	24.9	11.8	8.9	2
R. chrysopsis chrysopsis	5	Mexico (State) and Morelos	24.3	11.7	9.3	2.2
R. chrysopsis tolucæ	1	Mexico: Volcan Toluca	24	11.5	9.3	2.2
R. chrysopsis orizabæ	1	Puebla: Mount Orizaba	......	10.7	9	2
R. perotensis	1	Vera Cruz: Cofre de Perote	23.2	11	9.1	2
R. mexicanus mexicanus	5	Vera Cruz; Oaxaca; Guatemala	23.1	11.3	8.7	1.8
R. mexicanus goldmani	1	Puebla: Metlaltoyuca	24	11.5	9.5	1.7
R. mexicanus cherrii	6	Costa Rica: La Carpintera, San Pedro	23.7	11.7	8.1	1.7
R. milleri	4	Colombia: Munchique	22.5	11.2	7.6	1.4
R. söderströmi	2	Ecuador: Quito	24.2	11.5	9	1.8
R. gracilis	3	Yucatan: Chichen Itza; Campeche: Yohaltun.	21.6	10.5	7.5	1.7
R. tenuirostris tenuirostris	1	Guatemala: Todos Santos	25.7	12.5	9.1	1.7
R. tenuirostris aureus	1	Guatemala: Calel	25.2	12.1	9.6	1.7
R. creper	1	Panama: Volcan de Chiriqui	25.4	11.6	8.8	1.9
R. microdon microdon	3	Guatemala: Todos Santos, Volcan Santa Maria.	22.3	11.1	8.5	1.3
R. microdon albilabris	1	Oaxaca: Cerro San Felipe	22.3	11.4	7.8	1.3

PLATE IV.

[Twice natural size.]

FIG. 1. *Reithrodontomys humulis humulis*. Raleigh, N. C. (No. 189304, U. S. Nat. Mus., Merriam Coll.)

2. *Reithrodontomys humulis merriami*. Austin Bayou, Tex. (No. 44849, U. S. Nat. Mus., Biological Survey Coll.)

3. *Reithrodontomys albescens griseus*. Type, San Antonio, Tex. (No. 87852, U. S. Nat. Mus., Biological Survey Coll.)

4. *Reithrodontomys albescens albescens*. Type, Kennedy, Nebr. (No. 116358, U. S. Nat. Mus., Biological Survey Coll.)

5. *Reithrodontomys montanus*. Medano Ranch, Costilla County, Colo. (No. 150714, U. S. Nat. Mus., Biological Survey Coll.)

6. *Reithrodontomys megalotis megalotis*. Dry Creek, Socorro County, N. Mex. (No. 158319, U. S. Nat. Mus., Biological Survey Coll.)

7. *Reithrodontomys megalotis dychei*. Onaga, Kans. (No. 147132, U. S. Nat. Mus., Biological Survey Coll.)

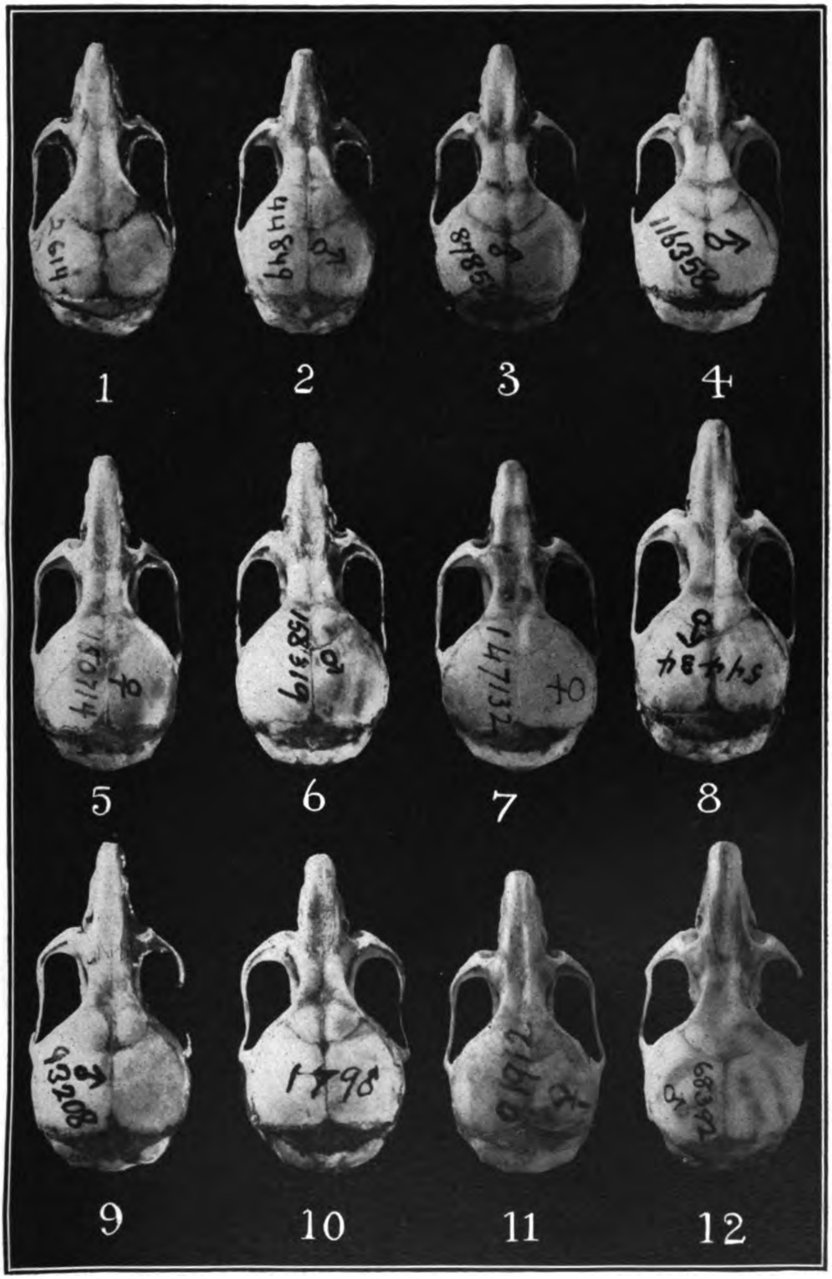
8. *Reithrodontomys megalotis saturatus*. Las Vigas, Vera Cruz. (No. 54434, U. S. Nat. Mus., Biological Survey Coll.)

9. *Reithrodontomys raviventris raviventris*. Berkeley, Cal. (No. 93206, U. S. Nat. Mus., Biological Survey Coll.)

10. *Reithrodontomys raviventris halicoetes*. Type, Petaluma, Cal. (No. 7146, Mus. Vert. Zool., Univ. California.)

11. *Reithrodontomys megalotis zacatecæ*. Valparaiso Mountains, Zacatecas. (No. 91912, U. S. Nat. Mus., Biological Survey Coll.)

12. *Reithrodontomys megalotis alticolus*. Type, Cerro San Felipe, Oaxaca. (No. 68392, U. S. Nat. Mus., Biological Survey Coll.)



SKULLS OF REITHRODONTOMYS.

1. **R. h. humulis.**
2. **R. h. merriami.**
3. **R. a. griseus.**
4. **R. a. albescens.**
5. **R. montanus.**
6. **R. m. megalotis.**
7. **R. m. dychei.**
8. **R. m. saturatus.**
9. **R. r. raviventris.**
10. **R. r. halicœtes**
11. **R. m. zacatecæ.**
12. **R. m. alticolus.**

PLATE V.

[Twice natural size.]

FIG. 1. *Reithrodontomys amœnus*. Type, Reforma, Oaxaca. (No. 14064, Field Mus. Nat. Hist.)

2. *Reithrodontomys otus*. Type, Sierra Nevada de Colima, Jalisco. (No. 45705, U. S. Nat. Mus., Biological Survey Coll.)

3. *Reithrodontomys australis*. Volcan Irazu, Costa Rica. (No. 116614, U. S. Nat. Mus., Biological Survey Coll.)

4. *Reithrodontomys dorsalis*. Type, Calel, Guatemala. (No. 77009, U. S. Nat. Mus., Biological Survey Coll.)

5. *Reithrodontomys colimæ colimæ*. Type, Sierra Nevada de Colima, Jalisco. (No. 45706, U. S. Nat. Mus., Biological Survey Coll.)

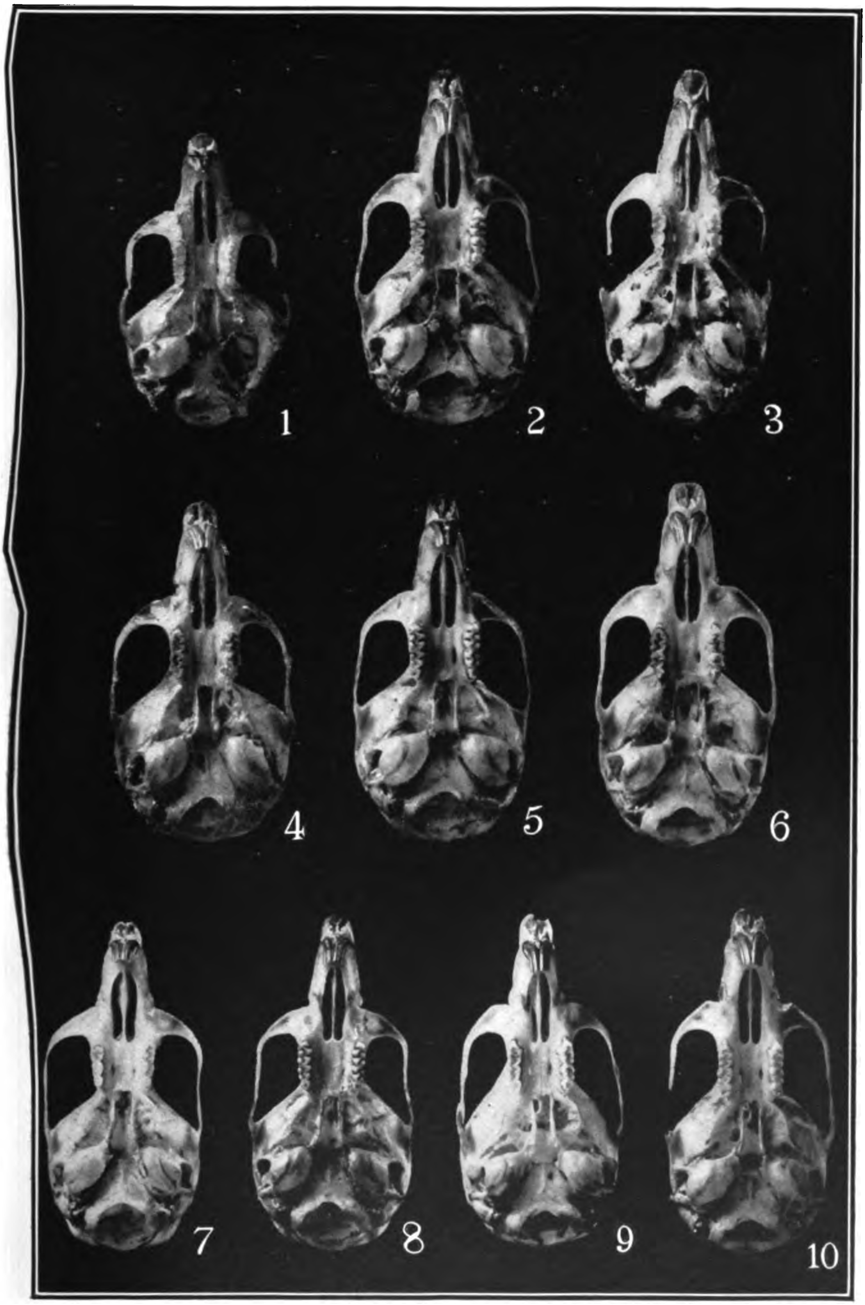
6. *Reithrodontomys rufescens luteolus*. Type, Juquila, Oaxaca. (No. 71558, U. S. Nat. Mus., Biological Survey Coll.)

7. *Reithrodontomys fulvescens tenuis*. Mazatlan, Sinaloa. (No. 96713, U. S. Nat. Mus., Biological Survey Coll.)

8. *Reithrodontomys fulvescens difficilis*. Orizaba, Vera Cruz. (No. 58268, U. S. Nat. Mus., Biological Survey Coll.)

9. *Reithrodontomys fulvescens helvolus*. Type, Oaxaca, Oaxaca. (No. 68387, U. S. Nat. Mus., Biological Survey Coll.)

10. *Reithrodontomys fulvescens toltecus*. Type, Tlalpam, D. F., Mexico. (No. 50746, U. S. Nat. Mus., Biological Survey Coll.)



SKULLS OF REITHRODONTOMYS.

1. R. amœnus.
2. R. otus.
3. R. australis.
4. R. dorsalis.
5. R. c. colimæ.
6. R. r. lutolus.
7. R. f. tenuis.
8. R. f. difficilis.
9. R. f. helvolus.
10. R. f. toltecus.

PLATE III.

[Twice natural size.]

FIG. 1. *Reithrodontomys hirsutus*. Type, Ameca, Jalisco. (No. 82200, U. S. Nat. Mus., Biological Survey Coll.)

2. *Reithrodontomys levipes*. Type, San Sebastian, Jalisco. (No. 88057, U. S. Nat. Mus., Biological Survey Coll.)

3. *Reithrodontomys chrysopsis chrysopsis*. Type, Mount Popocatepetl, Mexico. (No. 52031, U. S. Nat. Mus., Biological Survey Coll.)

4. *Reithrodontomys mexicanus mexicanus*. Jalapa, Vera Cruz. (No. 108538, U. S. Nat. Mus., Biological Survey Coll.)

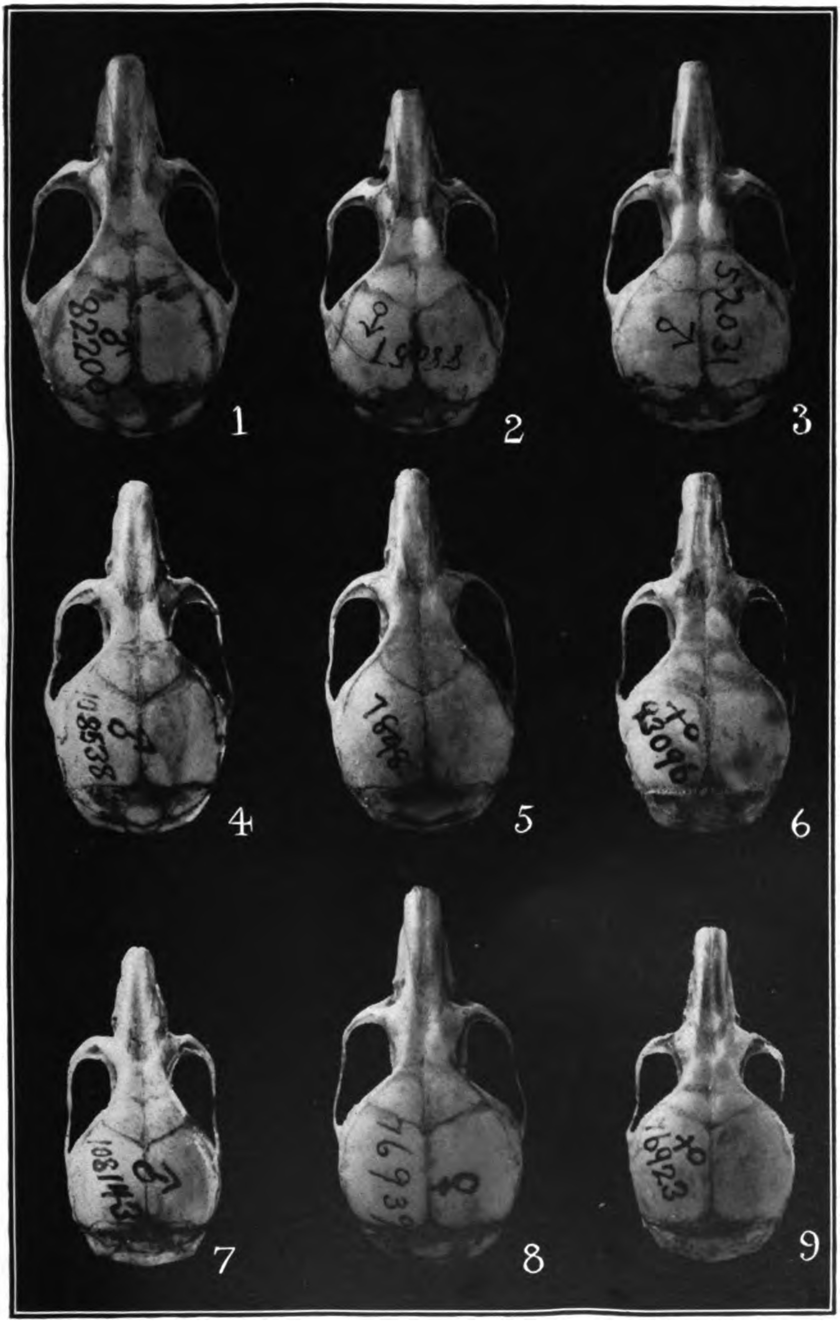
5. *Reithrodontomys mexicanus cherrii*. La Carpintera, Costa Rica. (No. 7898, Am. Mus. Nat. Hist.)

6. *Reithrodontomys mexicanus goldmani*. Type, Metlaltoyuca, Puebla. (No. 93096, U. S. Nat. Mus., Biological Survey Coll.)

7. *Reithrodontomys gracilis*. Chichen Itza, Yucatan. (No. 108143, U. S. Nat. Mus., Biological Survey Coll.)

8. *Reithrodontomys tenuirostris aureus*. Type, Calel, Guatemala. (No. 76939, U. S. Nat. Mus., Biological Survey Coll.)

9. *Reithrodontomys microdon microdon*. Type, Todos Santos, Guatemala. (No. 76923, U. S. Nat. Mus., Biological Survey Coll.)



SKULLS OF REITHRODONTOMYS.

1. R. hirsutus.
2. R. levipes.
3. R. c. chrysopsis.
4. R. m. mexicanus.
5. R. m. cherrii.
6. R. m. goldmani.
7. R. gracilis.
8. R. t. aureus.
9. R. m. microdon.

PLATE VII.

[Teeth about 10 times natural size; skulls twice natural size.]

FIGS. 1, 7. *Reithrodontomys* (*Reithrodontomys*) *megalotis megalotis*.
    Fig. 1. Side view of upper molars. (No. 167353, U. S. Nat. Mus., Biological Survey Coll.)
    Fig. 7. Worn crowns of upper molars. (No. 58090, U. S. Nat. Mus., Biological Survey Coll.)
2. *Reithrodontomys* (*Aporodon*) *tenuirostris aureus*. Side view of upper molars. (No. 77008, U. S. Nat. Mus., Biological Survey Coll.)
3, 5. *Reithrodontomys* (*Aporodon*) *levipes*.
    Fig. 3. Worn crowns of lower molars. (No. 88057, U. S. Nat. Mus., Biological Survey Coll.)
    Fig. 5. Worn crowns of upper molars. (No. 88057, U. S. Nat. Mus., Biological Survey Coll.)
4, 9, 10, 11. *Reithrodontomys* (*Aporodon*) *mexicanus mexicanus*.
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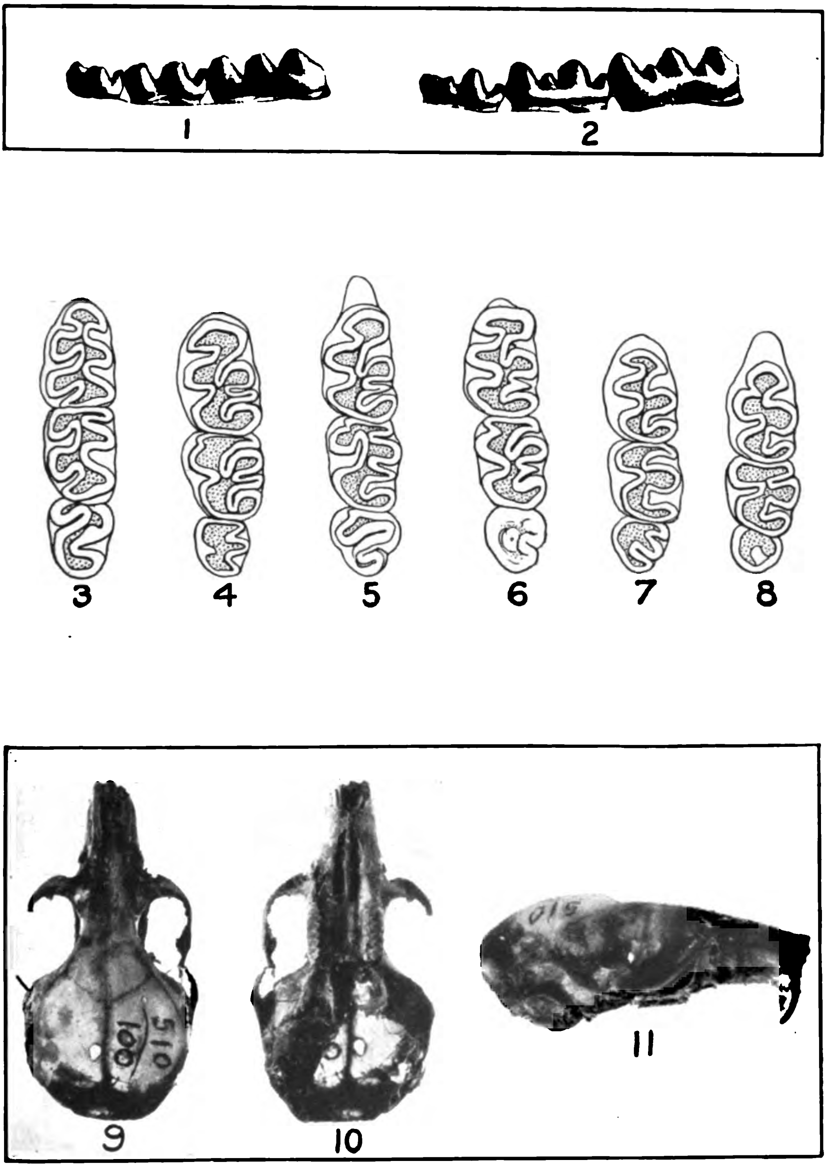
8. *Reithrodontomys* (*Reithrodontomys*) *humulis merriami*. Worn crowns of upper molars. (No. 178261, U. S. Nat. Mus., Biological Survey Coll.)



MOLAR TEETH AND SKULLS OF REITHRODONTOMYS.

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2. R. t. aureus.
3. R. levipes.
4. R. m. mexicanus.
5. R. levipes.
6. R. c. chrysopsis.
7. R. m. megalotis.
8. R. h. merriami.
9. 10. 11. R. m. mexicanus.

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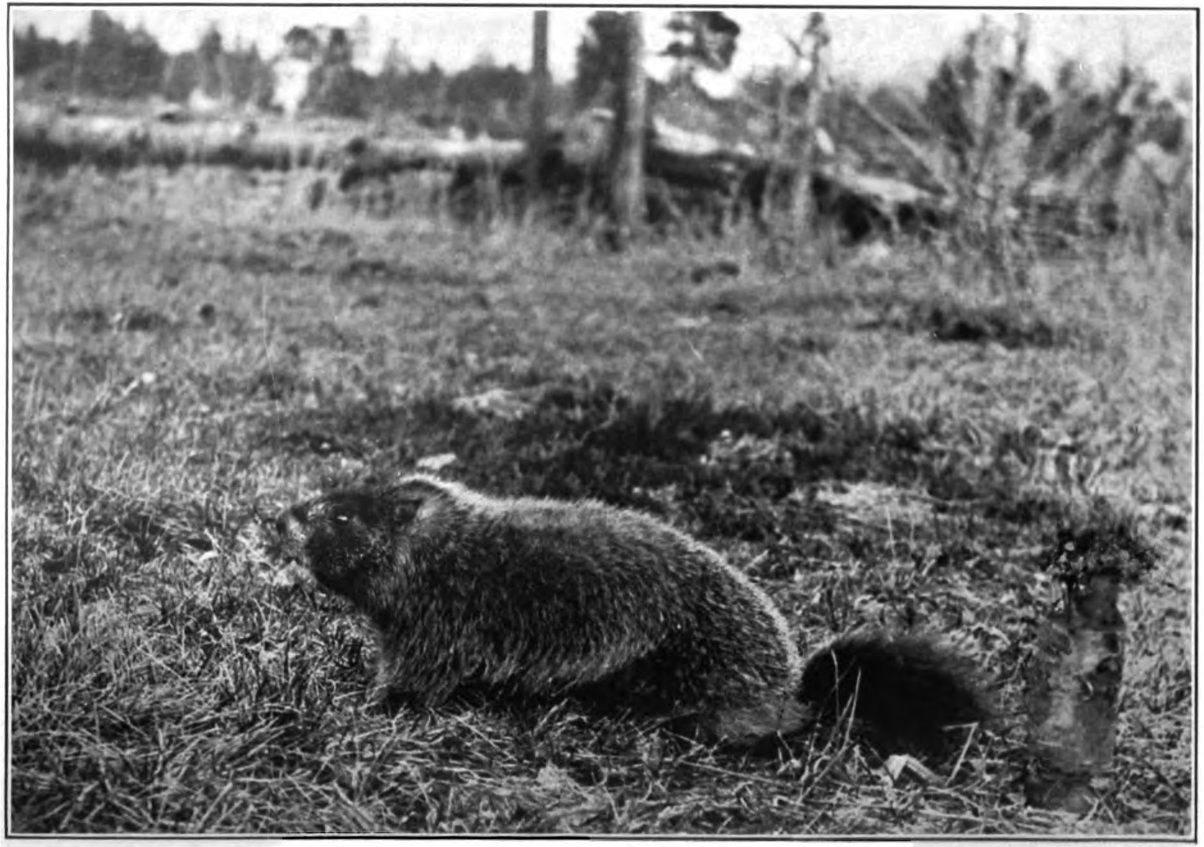

GOLDEN-MANTLED MARMOT (MARMOTA FLAVIVENTRIS NOSOPHORA).

[From life; Florence, Mont., April, 1910.]

U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF BIOLOGICAL SURVEY
HENRY W. HENSHAW, *Chief*

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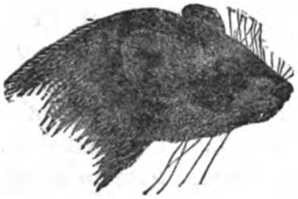

REVISION OF THE AMERICAN MARMOTS

BY

ARTHUR H. HOWELL
ASSISTANT BIOLOGIST, BIOLOGICAL SURVEY

WASHINGTON
GOVERNMENT PRINTING OFFICE
1915

LETTER OF TRANSMITTAL.

United States Department of Agriculture,
Bureau of Biological Survey,
Washington, D. C., October 21, 1914.

Sir: I have the honor to transmit herewith for publication as North American Fauna No. 37 a revision of the American marmots, by Arthur H. Howell, assistant biologist of the Biological Survey.

Although marmots are found over most of the United States and Canada, the relationships and ranges of the several species until now have been very imperfectly known. The present report furnishes descriptions of 26 forms and contains a series of maps showing their geographic distribution. In many localities marmots are a decided pest to agriculture, especially in the East, both because they are destructive to crops and because their burrows seriously interfere with farming operations. Moreover, marmots are known to carry the germs of Rocky Mountain spotted fever and other diseases. The animals are hence of considerable economic importance.

Respectfully,

Henry W. Henshaw,
Chief, Biological Survey.

Hon. David F. Houston,
Secretary of Agriculture.

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No. 37. NORTH AMERICAN FAUNA. April, 1915.

REVISION OF THE AMERICAN MARMOTS.

By Arthur H. Howell.

INTRODUCTION.

The American marmots, more often called woodchucks or ground hogs, are among the best known of our native wild mammals. They naturally divide into three distinct groups: (1) The woodchucks (*Marmota monax* group) of eastern United States and Canada; (2) the yellow-footed marmots (*M. flaviventris* group) of western United States and southern British Columbia; and (3) the hoary marmots (*M. caligata* group), chiefly restricted to the higher mountains of western North America. The present paper is a revision of the American species only, as it was not possible at this time to include a discussion of the Eurasian forms of the genus.

HISTORY AND NOMENCLATURE.

Widely distributed, in many places abundant, diurnal in habit, and frequently destructive to crops, the eastern species (*monax*) quickly attracted the attention of the early settlers, and through the medium of skins or captive animals sent to Europe soon became known to naturalists.

The first reference in literature to the American marmots dates from 1703, when Baron La Hontan published a very brief account of the woodchuck of eastern Canada, based on his observations in the region about Lake Champlain.[1] The name "siffleur" which he applied to the animal was carried by the French voyageurs throughout the northwestern fur countries and still is current among the French Canadians of the Eastern Provinces.

Catesby, in 1743, gave a brief description of the eastern woodchuck under the name of "The Monax,"[2] and a few years later, in 1747, Edwards published a more extended account with a very inaccurate figure of the animal under the title of "The Monax or Marmotte of America."[3] Edwards's description and figure were copied by many subsequent authors and furnished also the basis of the first technical name applied to the species—*Mus monax* Linnaeus.[1] While the figure is wholly unrecognizable, the description is sufficiently clear to warrant the use of the name bestowed by Linnaeus.

---

[1] La Hontan, Baron de. Voyages dans l'Amerique, 1703, p. 81.

[2] Catesby, Mark. Nat. Hist. of Carolina, etc., II, 1743, App., p. xxviii.

[3] Edwards, George. Nat. Hist. Uncommon Birds, II, 1747, p. 104, pl. civ.

Erxleben, in 1777, named the Canadian woodchuck (now recognized as a subspecies of *monax*) "*Glis*" *canadensis*,[2] and Pallas in the following year renamed it "*Mus*" *empetra*,[3] both descriptions being based on the "Quebec marmot" of Pennant.[4] Blumenbach, in 1779, named the genus *Marmota*,[5] and Schreber the following year introduced the name *Arctomys monax* on a plate evidently copied from Edwards's figure of "The Monax."[6] Schreber's generic name, though of later date than Blumenbach's, received general acceptance and continued in common use for the marmots until the early years of the present century, when the name *Marmota* was restored as the proper appellation of the genus.[7] In 1788, Gmelin proposed the name *Arctomys pruinosa*,[8] based on the hoary marmot of Pennant, and this name was used for that animal until 1888, when Tyrrell showed that it had been incorrectly applied and proposed to use in its place *Arctomys caligata* Eschscholtz, first described in 1829.[9]

Sabine, in 1822, published an account of the American marmots, recognizing three species: *monax*, *empetra* (=*canadensis*), and *pruinosa* (=*caligata*).[10] His descriptions of *monax* and *pruinosa* were copied from previous authors, but that of *empetra* was drawn from a specimen in the British Museum, and furnished apparently the first correct description of any American marmot. The first accurate drawing of an American species is that of the Canadian woodchuck published by Richardson in the Fauna Boreali-Americana (1829).

In 1836 King, recognizing clearly that *pruinosa* of Gmelin was not applicable to the hoary marmot, but overlooking Eschscholtz's name *caligata*, proposed the name *Arctomys okanaganus* for a marmot of this group obtained in southern British Columbia, and gave a very full and accurate description and a good figure of the animal, drawn from a living specimen which he sent to the Zoological Gardens in London.[11] His name, however, was not accepted by zoologists, and *pruinosa* continued in use for many years. The specimen taken by King was seen by Audubon in London, and furnished the basis of his figure of the hoary marmot in the "Quadrupeds of North America," but the illustration is colored much too brown to represent the animal correctly. In the work referred to[1] the authors gave also an extended account and a good drawing of the eastern woodchuck, and a shorter account, with a figure, of the yellow-bellied marmot of western North America, first described by them in 1841 under the name *Arctomys flaviventer*. This is the first appearance in literature of the widely distributed group of yellow-footed marmots, and the work of Audubon and Bachman was the first treatise in which all three groups of American species were recognized.

---

[1] The use of the name "monax" by both Catesby and Edwards independently (Edwards states that he had never seen an account of the animal) indicates that it came from the vernacular—a theory which is strengthened by the fact that the animal is still called "moonack" in parts of southern Virginia.

[2] Erxleben, J. C. P. Syst. Anim., Mamm., 1777, p. 363.

[3] Pallas, P. S. Nov. Spec. Glir., 1778, p. 74.

[4] Pennant, Thomas. Syn. Quad., 1771, p. 270, Plate 24, fig. 2.

[5] Blumenbach, J. F. Handb. der Naturgesch., I, 1779, p. 79.

[6] Schreber, J. C. D. von. Säugthiere, pl. ccviii, 1780; text, IV, 1782, p. 737.

[7] Trouessart, E. L. Cat. Mamm., Suppl., 1904, p. 343.

[8] Gmelin, J. F. Syst. Nat., I, 1788, p. 144.

[9] Tyrrell, J. B. Proc. Can. Inst., 3d Ser., VI, 1888, p. 88.

[10] Sabine, Joseph. Trans. Linn. Soc. London, XIII, 1822, pp. 579-591.

[11] King, R. Narr. Journ. to Shores of Arctic Ocean, II, 1836, pp. 232-248.

Little advance in knowledge of the genus was made for nearly half a century, and the three groups (*monax*, *flaviventris*, and *caligata*) continued to be known by only a single species in each. The Canadian woodchuck, so clearly described by Sabine and Richardson, was considered by both Baird and Allen to be identical with *monax* (of which it is, indeed, a subspecies) and the names based on it (*canadensis* Erxleben, *empetra* Pallas, *melanopus* Kuhl) were placed by them in synonymy, but were later revived by several authors.[2]

In 1889 Merriam described *dacota*, a member of the *flaviventris* group, from the Black Hills, S. Dak.; and in 1898, *olympus*, a member of the hoary marmot group, from the Olympic Mountains, Wash. In 1899 Bangs named *ignava* from Labrador and *avara* from southern British Columbia; in 1905 J. A. Allen described *engelhardti* from Utah; in 1909 Heller proposed *vigilis* for a hoary marmot from Alaska; in 1911 Swarth named *ochracea* from Alaska and *vancouverensis* from British Columbia; and in 1912 Hollister proposed the name *sibila* for a hoary marmot from the northern Rocky Mountains, but as this name was found to be preoccupied the species was renamed by him *oxytona* in 1914. The present writer, after making a preliminary study of the group, added, in 1914, 10 new forms to the 13 currently recognized.[3] Two additional new races are here described and one old name (*okanagana*) is revived, making a total of 26 forms recognized in this revision.

VERNACULAR NAMES.

The marmots of the *monax* group are known in the Northern States as woodchucks, and in the Southern States as ground hogs, the European name marmot being practically unknown in eastern North America. In eastern Canada, among the French Canadians, the name "siffleur" is current, and in central Canada the Cree Indian name "wenusk" is generally used. In southern Virginia, as I am informed by Edward A. Preble, the woodchuck is locally known as "moonack," which is probably a corruption of the original name "monax" used by both Catesby and Edwards.

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[1] Audubon & Bachman. Quad. N. Am., I, 1841, pp. 16–24, pl. ii; III, 1854, pp. 17–20, pl. ciii; pp. 160–162, pl. cxxxiv.

[2] Rhoads, S. N., Proc. Acad. Nat. Sci. Phila., 1897, p. 30; Allen, J. A., Bul. Amer. Mus. Nat. Hist., X, 1898, p. 456; Preble, E. A., N. Am. Fauna No. 22, 1902, p. 47; Ibid., No. 27, 1908, p. 159.

[3] Howell, A. H. Proc. Biol. Soc. Washington, XXVII, 1914, pp. 13–18.

The yellow-footed marmots (*flaviventris* group) are commonly called woodchucks or rockchucks, more rarely ground hogs or marmots.

The hoary marmots (*caligata* group) are most often known as ground hogs, whistlers or "siffleurs," sometimes as whistling "pigs," whistling marmots, or "badgers."

HABITS.

The eastern woodchucks live for the most part in pairs or family groups, the yellow-footed marmots in more or less scattered colonies, while the hoary marmots are more strongly gregarious. All the species live in burrows which they dig for themselves. In regions where rock piles, rock ledges, or stone walls occur the burrows are usually excavated underneath or among rocks, but natural openings in cliffs are often utilized for dens.

Eastern woodchucks (*monax* group), while preferring rocky bluffs or stone walls for a habitation, often live in meadows devoid of rocks and where the burrows are surrounded by an abundant growth of grass or clover.

Yellow-footed marmots (*flaviventris* group) usually live either on rocky hillsides, in the crevices of cliffs, or beneath rock piles in meadows. They frequently make their burrows beneath unoccupied buildings, but are never found far from hills, and are often abundant in the higher parts of mountains.

Hoary marmots (*caligata* group), when living at timber line in the mountains, as is their invariable habit in the southern part of their range, are always found in or about rock slides, but in Alaska and northern British Columbia, where they frequently descend to low altitudes, they often make their burrows in grassy flats or on open hillsides.

All the species are mainly terrestrial, but the eastern woodchucks occasionally climb into trees and bushes. They are not at home, however, in such situations, and as a rule may easily be dislodged. The tree-climbing habit appears to be more strongly marked in the woodchucks of the Mississippi Valley than in those inhabiting the Atlantic States. Charles Aldrich, of Webster City, Iowa, has recorded an instance of a woodchuck ascending an oak tree to a height of 40 feet,[1] and Dr. F. W. Langdon states that in Ohio he has seen one descend the perpendicular trunk of a large sugar maple, *head first*.[2] In Minnesota and Wisconsin, as I am informed by Vernon

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[1] Aldrich, Charles. Am. Naturalist, XV, 1881, p. 737.

[2] Langdon, F. W. Journ. Cincinnati Soc. Nat. Hist., III, 1880, p. 305.

Bailey and H. H. T. Jackson, it is a common occurrence for woodchucks to take to trees when pursued by dogs.

The eastern woodchuck is mainly diurnal, but occasionally is found abroad at night also, especially by moonlight. Merriam says of it:

> In summer, throughout the farming districts, they commonly leave their burrows early in the morning, late in the afternoon, and during moonlight nights, but may sometimes be found abroad at all hours. As autumn approaches, and they become more and more fat and sleepy, they usually appear only in fine weather, and then but for a few hours in the hottest part of the afternoon.[1]

The yellow-footed and hoary marmots are fond of sunning themselves on projecting points of rock where they are safe from attack and may overlook a wide stretch of country. During cloudy and stormy weather they are less active and spend a larger part of the time in their burrows.

All the American marmots when alarmed utter a loud, shrill whistle, a habit apparently most pronounced in the hoary marmot, whose notes are much stronger than those of the smaller species and capable of being heard at a distance of more than a mile. This habit has given the name "whistler" to the hoary marmot and "siffleur" to the woodchuck of eastern Canada.

BURROWS.

Although originally living in the woods, the eastern woodchuck prefers clearings for its abode, and, as a result of an abundance of easily obtained food, is now probably much more numerous than in primitive times. Its burrows are commonly excavated in the face of a bluff, in a grassy meadow, or underneath a stone wall, a stump, or the roots of a tree.

Merriam states that the burrows are of two principal types—

> * * * the first slopes at a moderate angle from the surface and has a mound of dirt near its entrance; the other is more or less vertical for several feet (often a metre or more) immediately below the surface, and no loose earth can be found in its neighborhood. * * * As a rule they [the galleries] slant abruptly downward from the entrance to a depth of from three to four feet * * * , whence inclining slightly upward and usually curving to one side, they extend horizontally for a varying distance (commonly from 10 to 25 feet) * * *. Two or more short lateral branches are generally given off from the main gallery, and lead, sloping upward and then downward, to the more or less circular chambers that contain the animals' nests. It has been my invariable experience to find these chambers above the level of the bottom of the entrance incline, and I have seen one that was within a foot and a half * * * of the surface. The nest itself is usually composed of dry grasses and leaves and rarely exceeds a foot in diameter. * * * The main gallery or one of its branches commonly terminates in a slight excavation, which is found to contain the animal's excrement.[2]

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[1] Merriam, C. H. Mamm. of the Adirondacks, Trans. Linn. Soc. N. Y., II, 1884, p. 146.

[2] Ibid., pp. 148–149.

William Hubbell Fisher excavated and measured nine burrows of the woodchuck in Lewis County, N. Y., and has published a detailed description of them, with diagrams. The longest burrow which he examined measured (including side branches) 44 feet 9½ inches; the shortest, 6 feet 8¼ inches; the deepest burrow was 49 inches below the surface; the shallowest, 23 inches.[1]

No description of the burrows of the yellow-footed marmot has come to the writer's notice, and the only known account of those of the hoary marmots is that given by William H. Wright in his work on the grizzly bear. Describing the manner in which a grizzly had opened up a den of these marmots, he says:

> The den ran in under several layers of loose flat rocks, some of which were two or three feet long by half as many wide, and several inches thick. These he had ripped out easily and thrown down hill, and the dirt and small bowlders had been hurled out and now covered the snow all about for a space of ten or twelve feet.
>
> On the rocks and snow were large spots and blotches of blood, telling of the feast that had rewarded his labors, and that there had been more than one marmot was shown by the numerous tracks. These animals had burrowed down some six or seven feet into the side of the mountain, and under a large flat stone they had scooped out a little cave, some three feet in diameter, where they had a soft bed of grasses that they had carried in. When the grizzly broke his way into their home there had been a great rush for freedom.

The marks in the snow indicated that all the marmots had been devoured by the bear.[2]

HIBERNATION.

All the species hibernate for periods varying from 4 to 6 months. Merriam states that in New York, along the western border of the Adirondacks, the woodchuck usually goes into winter quarters between the 18th and 25th of September and reappears the middle or latter part of March; in early springs following mild winters, he adds, "woodchucks occasionally appear in February, but reenter their burrows and again become dormant if the temperature falls."[3] Bachman states that he once observed a woodchuck in New York State on October 23 sunning himself at the mouth of his burrow, and also in the same State saw one killed by a dog on March 1.[4] Extreme dates of occurrence for this region are: February 22, Adirondack Mountains, N. Y., specimen in the Merriam collection; and November 20, Fort Miller, N. Y., one seen by Dr. E. A. Mearns.[5] In the more southern States, hibernation covers a shorter period, as indicated by the occurrance of the animals at the base of Roan Mountain,. N. C., as early as February 7 and as late as October 23. Other dates of late occurrence are as follows: October 6, Teslin Lake, Yukon; October 17, Dowagiac, Mich.; October 25, Johnson County, Iowa. Hahn states that in southern Indiana woodchucks usually retire about the middle of October and begin to clean out and enlarge their burrows during the last days of February.[1]

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[1] Fisher, W. H. Jour. Cincinnati Soc. Nat. Hist., XVI, 1893, pp. 105–123.

[2] Wright, W. H. The Grizzly Bear, London, 1909, p. 82.

[3] Merriam, C. H. Mamm. of the Adirondacks, Trans. Linn. Soc. N. Y., II, 1884, pp. 143–144.

[4] Audubon & Bachman. Quad. N. Am. I, 1849, p. 20.

[5] Mearns, E. A. Bul. Amer. Mus. Nat. Hist., X, 1898, p. 337.

The yellow-footed marmots go into hibernation between the middle of August and the first of October, the date varying with the altitude and local conditions. Individuals living in the valleys retire earlier than those living higher up in the mountains. Warren states that in Gunnison County, Colo., this species dens up about the first of October, but individuals are sometimes seen much later.[2] Allan Brooks states (in epistle) that at Okanogan Landing, British Columbia, practically all these marmots disappear before the middle of August, but he has occasionally seen their tracks as late as early October. In the mountains of Montana and Wyoming this species usually enters hibernation during the last of August or the first of September; Biological Survey field parties have never found the animals later than the first week in September. In the Bitterroot Valley, Mont., the first one seen in the spring in 1910 was on March 24, and by April 1 they were numerous; in 1911 one was seen there by Bernard Bailey, on March 13. In western Oregon extreme dates of occurrence are: February 4 (Klamath Lake), and September 25 (Mount Hood).

The hibernating period of the hoary marmot begins the last of September or first of October. Near Tatletuey Lake, British Columbia, Edward A. Preble found the species still active a few hundred feet above timber line on September 23 and 25, but none was seen after the latter date. Like the yellow-footed species, the hoary marmots retire earlier in the valleys than in the mountains. Heller states that at Valdez Narrows, Alaska, the species went into hibernation about the middle of September.[3]

Bachman thus described his observations of a pair of hibernating marmots:

> In the summer of 1814, in Rensselaer County, in the State of New York, we marked a burrow which was the resort of a pair of marmots. In the beginning of November the ground was slightly covered with snow, and the frost had penetrated to the depth of about an inch. We now had excavations made in a line along the burrow or gallery of the marmots, and at about twenty-five feet from the mouth of the hole; both of them were found lying close to each other in a nest of dried grass, which did not appear to have been any of it eaten or bitten by them. They were each rolled up, and looked somewhat like two misshapen balls of hair, and were perfectly dormant. We removed them to a haystack, in which we made an excavation to save them from the cold. One of them did not survive the first severe weather of the winter, having,

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[1] Hahn, W. L. Mamm. of Indiana, 1909, pp. 481–482.

[2] Warren, E. R. Mamm. of Colorado, 1910, p. 148.

[3] Heller, Edmund. Univ. of California Pub. Zool., V, 1910, p. 339.

as we thought on examining them, been frozen to death. The other, the male, was now removed to a cellar, where he remained in a perfectly dormant state until the latter part of February, when he escaped before we were aware of his reanimation. We had handled him only two days previously, and could perceive no symptoms of returning vivacity.[1]

The following account of a yellow-footed marmot (*Marmota flaviventris* subsp.) found in midwinter in the Silver Mountain tunnel at Ophir, Colo., probably indicates a common method of hibernation in that species:

> * * * [He] had packed in grass for a nest, and taken up his winter quarters. He was rolled up like a ball, with his forepaws over his eyes; we pulled his paws away, and his eyes were closed; all our efforts to awake him were futile; he would yawn like a boy that had been disturbed when sleeping soundly, return his paws to his eyes, and curl himself up in his original position.[2]

BREEDING.

The eastern woodchuck usually produces from 4 to 6 young at a birth. Bachman states, however, that on two occasions he counted 7 and on another 8 young in a litter, and H. H. T. Jackson informs me that he once saw a litter of 9. In New York State, according to Merriam, this species brings forth its young the last of April or first of May. In the Southern States they are born somewhat earlier.

The yellow-footed marmots breed at about the same season as their eastern relatives and produce from 3 to 8 young at a birth. In the Bitterroot Valley, Montana, 5 females collected between April 8 and April 16 were pregnant, the number of embryos being in most cases 5 or 6 (in one case 3). Young marmots were out in numbers in that region on May 30. Warren states that an individual of this species collected at Sulphur Springs, Colo., on May 4, contained 8 embryos.[3]

The hoary marmots probably breed somewhat later than their smaller relatives, but little information on this point is available. A female specimen of *Marmota caligata nivaria*, taken May 27, 1895, near St. Marys Lake, Mont., contained 5 embryos. Swarth states that in southern Alaska young individuals of *M. c. caligata* were seen running about in the middle of June, but on Vancouver Island, during the first three weeks of July, no young ones [of *M. vancouverensis*] had yet emerged from the burrows.[4]

FOOD.

The principal food of the eastern woodchuck is clover, alfalfa, and grass, and the animals do considerable damage to these crops both by consuming the forage and by trampling down much that they do not eat. Cultivated crops and orchard trees are occasionally injured by them, but the damage usually is not serious. Evermann and Clark state that in Indiana woodchucks—

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[1] Audubon & Bachman. Quad. N. Am., I, 1849, p. 22.

[2] Osborn, S. E. The Observer, III, 1892, p. 32.

[3] Warren, E. R. Mamm. of Colorado, 1910, p. 148.

[4] Swarth, H. S. Univ. of California Pub. Zool., X, 1912, p. 90.

> * * * sometimes damage young corn plants and occasionally feed on the leaves of pumpkin, squash, and bean vines. They sometimes visit the kitchen garden and do more or less damage to the cabbage heads and celery.[1]

Brooks, writing of the woodchuck in West Virginia, says:

> * * * Feeds on corn in the roasting-ear, which it procures by breaking down the stalks; is also fond of pumpkins, young beans, grass and other cultivated crops. Frequently gnaws and scratches the bark of young fruit trees.[2]

Hahn mentions capturing a woodchuck in a sassafras tree and finding its stomach gorged with sassafras leaves.[3] Dr. Witmer Stone states that the woodchuck sometimes eats cantaloupes.

The food of yellow-footed marmots is similar to that of eastern woodchucks, but probably includes a larger proportion of wild plants and less grass and clover. Vernon Bailey found in the stomachs of the Black Hills marmot flowers, leaves, and green seeds of various plants, including *Astragalus bisulcatus* and *Sedum douglasii*. In dry excrement of marmots at Spokane Bridge, Wash., he found the seeds of *Amelanchier alnifolia* and *Rubus nutkanus*. Birdseye states that the marmots in the Bitterroot Valley, Montana, feed on timothy, clover, alfalfa, dandelions, and other native plants. He says:

> In hayfields they consume a very considerable amount of feed; and beans, carrots, potato vines, cabbage, and other garden truck are almost sure to suffer whenever woodchucks have access to them.[4]

Little is known definitely concerning the food habits of hoary marmots, but they doubtless feed, like the other species, on grass and the tender leaves and stems of native plants.

ECONOMIC STATUS.

As already shown, the food habits of the American marmots make the animals a decided pest wherever they occur about cultivated lands. In this respect the woodchucks of the Eastern States are the chief offenders, and the farmers of that region wage constant warfare on the animals, with indifferent success. Where the woodchucks occupy mowing lands they not only consume considerable grass and tread down much more which can not be cut by a mowing machine, but their burrows and mounds make it difficult and dangerous to operate a mower. Horses sometimes are injured by stepping into the holes made by woodchucks, and the knives of the machines are liable to be dulled or broken by running into piles of earth or rocks. Vernon Bailey states that he has seen an acre of oats on a hillside in New York State almost ruined by a family of woodchucks, their trails having broken down most of the grain which they had not cut to eat.

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[1] Evermann & Clark. Proc. Washington Acad. Sci., XVII, 1911, p. 13.

[2] Brooks, F. E. Report W. Va. Board Agr. for 1910 (1911), p. 15.

[3] Hahn, W. L. Mamm. of Indiana, 1909, p. 482.

[4] Birdseye, Clarence. Farmers' Bul. 484, U. S. Dept. Agr., 1912, p. 28.

The fur of the American marmots is not at present used commercially, but the hides of hoary marmots are employed to some extent by the Indians of western Canada for making robes. The fur of this animal is fully as good as that of the European and of some of the Asiatic species, all of which figure extensively in the fur trade. Furthermore, the American animal is larger than most of the Eurasian species, and the color pattern of its skin is such as to make a very handsome natural fur. If a sufficient number of these pelts could be secured in late autumn when they are in prime condition there would seem to be every reason for utilizing them in the fur trade. In parts of Alaska and northern British Columbia the animals are very abundant, and Indians of that region annually capture large numbers both for fur and flesh. The yellow-footed marmots are considerably smaller than the hoary marmots, but their pelage is long, full, and silky, and could readily be made into a very attractive fur. The pelage of the eastern woodchuck is much coarser and thinner and has never been considered of much value for fur; the hides, however, are tough and durable and might be utilized for some kinds of leather. Farmers' boys often tan the skins of the eastern woodchuck and make them into shoe strings, whip lashes, ball covers, or mit facings.

The flesh of marmots is said to be palatable and in certain regions of the Northwest furnishes an important food supply for the native Indians.

MARMOTS AS CARRIERS OF DISEASE.

For many years the opinion has generally prevailed that the marmots of central Asia are in some way concerned in the spread of the plague, and this theory was accepted even as late as 1911 by the members of the International Plague Conference held at Mukden in April of that year. Accounts have frequently been published in medical literature of the appearance of the disease among "tarbagan"[1] hunters under circumstances pointing strongly to the possibility of infection from handling the animals or consuming their flesh, but unfortunately none of these accounts shows bacteriological evidence of the existence of the plague among marmots, nor do they demonstrate conclusively that the disease is contracted in any way from the animals.[2]

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[1] This is the name applied in medical literature to the marmots of Asia. It is said to be of Mongolian origin. The Russian name of the animal is "churok."

[2] See especially an article by Dr. Frank G. Clemow, Jour. Trop. Medicine, February, 1900, pp. 169-174.

The last great outbreak of pneumonic plague in Manchuria, during the winter of 1910–11, was supposed to have started among tarbagan hunters in the town of Manchouli, a station on the Trans-Siberian Railway, whence it spread rapidly southward along the railway to Harbin and Mukden. Efforts were made during the progress of this epidemic to locate the disease among the native marmots,[1] and a number of individuals captured near Mukden were inoculated experimentally by Prof. Zabolotny and found susceptible to plague infection. One individual suffering from the disease was brought to him, this being the only known instance of the natural appearance of plague among marmots.[2] More recently a systematic effort has been made by the Chinese Government to discover the disease in nature, but the evidence obtained is wholly of a negative character.[3]

The experimental evidence just mentioned and the close relationship of marmots to ground squirrels, which are known to carry plague on the Pacific coast of North America, warrant looking upon these animals with suspicion whenever they occur in a plague-infested region.

One American species—the golden-mantled marmot (*Marmota flaviventris nosophora*)—is known to assist in spreading the deadly spotted fever by serving as host for the fever tick (*Dermacentor venustus*), both in adult and nymphal stages. Over 200 ticks have been taken from a single wild marmot, and when in captivity the species has been shown to be susceptible to spotted fever.[4] Since this marmot is not utilized for fur there is relatively little danger of the spread of the disease to other regions through the medium of the animals, but every effort should be made to exterminate them where they occur about cultivated lands or in the vicinity of dwellings. Suggestions for destroying marmots are given in Farmers' Bulletin 484, United States Department of Agriculture.

EXTERNAL CHARACTERS.

In the American marmots the body is thickset and clumsy; the head short and broad; the legs short and stout; and the tail rather short (about one-fifth to one-third of the total length), densely haired, and slightly flattened. The nose is broad and blunt, covered with hair to the edge of the nostrils, and the ears are short, broad, rounded, and well-haired. Tufts of long black bristles grow from the side of the head, one directly behind the nose, another underneath and between the eye and ear, and a third shorter tuft over the eye; small scattered bristles also are found under the chin. The eyes are rather small and nearly or quite circular. The feet are robust, with stout, slightly curved fossorial claws, those on the fore feet somewhat heavier; the thumb of the front foot (in the American species) is rudimentary and often very small, but bears a broad, flat nail; the third digit is the longest, the second and fourth subequal, the fifth decidedly shorter; the palm is naked, bearing 3 pads at the bases of the digits and 2 larger posterior ones; on the hind foot the third digit is slightly longer than the subequal second and fourth, the fifth and first successively much shorter; the sole is naked except at the heel and bears 6 pads, 4 at the bases of the digits and 2 posterior to them. The mammae number 5 pairs, except in the *monax* group, in which there are usually but 4 pairs. In *M. monax*, according to Baird, "there is a short, shallow cavity between the muscles of the jaw and the cheek, attaining a depth perhaps of half an inch or less and occupying the place of the internal pouch of *Tamias* and *Spermophilus* [*Citellus*]." [1]

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[1] The marmot of Manchuria, although generally referred to in plague literature as *Arctomys bobac*, is in all probability *Marmota sibirica*, specimens of which, collected at Urga, Mongolia, are in the U. S. National Museum.

[2] Strong, R. P. Rept. Intern. Plague Conference held at Mukden, April, 1911. Manila, 1912.

[3] Dr. Wu Lien Teh (G. L. Tuck). The Lancet, London, Aug. 23, 1913, pp. 529–535.

[4] Birdseye, Clarence. Farmers' Bul. 484, U. S. Dept. Agr., 1912, p. 28.

PELAGE AND MOLT.

The pelage of the American marmots consists of hairs of two kinds—a dense, soft, and somewhat woolly underfur, confined chiefly to the back and sides; and longer, somewhat coarser hairs covering the whole body, intimately mixed on the back with the underfur and projecting beyond the tips of the latter. The underfur is of two colors, usually some shade of gray or dark brown tipped with a lighter color, generally a shade of gray, buff, cinnamon, or reddish brown. The long hairs are also of two colors, usually a shade of brown, hazel, or black, tipped with a lighter shade—buff or white. The tips of the underfur usually show through the long hairs, and form an important element in the general color tone of the pelage. The hairs on the head and feet are shorter than on the rest of the body, and are unicolor to the roots; those on the tail are long and coarse, their bases of a darker shade than the tips. The hair on the underparts is shorter and sparser than on the back and is without underfur.

The pelage is renewed annually in summer, usually in August, sometimes in July or even June. Individuals taken in early spring, soon after emerging from hibernation, are usually in full, long pelage, but by midsummer the pelage often becomes very much worn and faded. There seems to be no uniform method of molting, the new pelage sometimes appearing in patches on various parts of the body. In a specimen of *Marmota olympus*, taken August 28, the new pelage was coming in in large patches, the molt being farthest advanced on the middle of the back, with streaks of new hair along the sides of the neck and body. (See Pl. II.) In another individual of the same species, taken August 18, new hair was coming in on the rump and hinder back, the old intimately mixed with the new. In an immature individual of *M. caligata cascadensis*, taken August 5, new pelage covered all of the body except the rump and tail. A somewhat similar condition is shown by an adult individual of *M. monax preblorum*, taken July 11, the new pelage coming in over the entire upperparts, farther advanced on the fore back and shoulders. In a specimen of *M. flaviventris nosophora*, taken June 7, the molt was just beginning in two patches on the hinder back. In a specimen of *M. f. obscura*, taken July 27, new pelage appears in the form of a band on the middle of the back reaching from the top of the head to the rump. (See Pl. II.)

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[1] Baird, S. F. Mamm. N. Am., Rept. Expl. and Surv. R. R. Pacif., VIII, 1857, p. 340. The author has had no opportunity to examine specimens of any of the groups in the flesh, so does not know whether this character is possessed by all.

MELANISM.

Melanism is most strongly developed in the subspecies *Marmota caligata vigilis*, occupying the region around Glacier Bay, Alaska. In this race some individuals are entirely black except for a few grayish hairs on the sides and neck, and small whitish patches on the underparts and nose. No purely black specimens of *M. monax* have been seen, but a melanistic phase is rather common in New York and New England. The darkest specimen seen (from Lake George, N. Y.) is dark blackish brown all over, except the head and face, which are mixed mummy brown and benzo brown. Other specimens from New York State are dark chestnut-brown. Vernon Bailey states that he has seen a very few black individuals in Minnesota.

A dark phase occurs also in *M. flaviventris luteola*, but this can hardly be said to be melanistic (see description under that species). A curious specimen of *M. f. avara* from Pullman, Wash., has the tips of the hairs of the head, fore back, and most of the underparts dark blackish brown, the hinder back being pale grayish mixed with dark brown.

MATERIAL EXAMINED AND ACKNOWLEDGMENTS.

The present revision is based on a study of 1,051 specimens, 722 of which are contained in the U. S. National Museum, including the Biological Survey and the Merriam collections; the remainder (329 specimens) have been borrowed from other museums and from private collections. For the loan of this material I desire to extend my thanks to the following: Dr. J. A. Allen, of the American Museum of Natural History; Messrs. Samuel Henshaw and Outram Bangs, of the Museum of Comparative Zoology; Dr. Witmer Stone, of the Academy of Natural Sciences, Philadelphia; Dr. W. J. Holland and Mr. W. E. Clyde Todd, of the Carnegie Museum; Dr. A. G. Ruthven, of the University of Michigan; Messrs. Charles B. Cory and W. H. Osgood, of the Field Museum of Natural History; Mr. C. D. Bunker, of the Kansas University Museum; Prof. C. C. Nutting, of the University of Iowa; Mr. J. D. Figgins, of the Colorado Museum of Natural

History; Dr. Joseph Grinnell, of the Museum of Vertebrate Zoology, University of California; Mr. P. A. Taverner, of the Victoria Memorial Museum; Mr. Arthur H. Helme, of Miller Place, N. Y.; Mr. H. H. T. Jackson, of the Biological Survey; and Mr. Edward R. Warren, of Colorado Springs, Colo.

EXPLANATION OF CRANIAL MEASUREMENTS.

Measurements of skulls of marmots, in millimeters, have been taken as follows:

Condylo-basal length.—From posterior border of condyle to most anterior point of premaxillae.

Palatal length.—From posterior border of palate (disregarding median process) to most anterior point of premaxillae.

Postpalatal length.—From posterior border of palate to inferior lip of foramen magnum.

Length of nasals.—From most anterior point to most posterior point.

Zygomatic breadth.—Greatest breadth across zygomata.

Breadth across mastoids.—Greatest breadth across mastoid processes.

Least interorbital breadth.—Shortest distance across frontals in front of postorbital processes.

Breadth of rostrum.—Greatest breadth of rostrum at most anterior points of maxillae.

Maxillary tooth row.—Alveolar length of maxillary molar-premolar tooth row.

Genus **MARMOTA** Blumenbach.

Glis Erxleben, Syst. Regni Anim., I, 1777, p. 358 (part). (Not *Glis* Brisson, 1762.)

Marmota Blumenbach, Handb. der Naturgesch., I, 1779, p. 79. Type, *Marmota alpina* [= *Mus marmota* Linnaeus].

Arctomys Schreber, Säugthiere, 1780, Plate CCVIII. Type, *Mus monax* Linnaeus.

GROUPS.

The American marmots embrace three very distinct groups as follows: (1) The *monax* group—all the eastern woodchucks, the Canada woodchuck, the British Columbia woodchuck and the ochraceous woodchuck of Alaska and northern British Columbia; (2) the *flaviventris* group—all the yellow-footed marmots; and (3) the *caligata* group—the hoary marmots, including the species *caligata*, *olympus*, and *vancouverensis*. The characters of the various groups are given in connection with the technical descriptions of the species.

A detailed study of Old World forms was not possible in the present revision, but, so far as known, none of the American species has any very near relative in Eurasia.[1] Several groups are represented there, some of the species resembling the *caligata* group in certain skull characters, others apparently being more nearly related to the *monax* group. *Marmota marmota*, the type of the genus, though widely differing from the American species in the greater depth and convexity of the cranium, resembles *monax* in the characters of the basioccipital, the shape of the postorbital processes, the relatively wide interorbital region, and the nearly parallel maxillary tooth rows. Most of the Asiatic species, however, apparently are more closely related to *M. caligata* than to either of the other American groups. The skulls of all American species, contrasted with those of the Eurasian species, show a marked flattening of the cranium, the dorsal outline of the skull being decidedly more convex in practically all Old World forms than in those of America. All the Eurasian species differ also in coloration from the American forms. All the American species possess a small rudimentary thumb bearing a flat nail—a character present in most of the Asiatic species, but absent in *M. marmota* of Europe.

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[1] The species living in eastern Siberia has not been seen.

List of American Species and Subspecies, with Type Localities.

Marmota monax group:	
Marmota monax monax (Linnaeus)	Maryland.
monax rufescens Howell	Elk River, Minn.
monax preblorum Howell	Wilmington, Mass.
monax ignava (Bangs)	Black Bay, Labrador.
monax canadensis (Erxleben)	"Canada et ad fretum Hudsonis"—fixed at Quebec, Quebec.
monax petrensis nobis	Revelstoke, British Columbia.
monax ochracea Swarth	Head of Fortymile Creek, Alaska.
Marmota flaviventris group:	
Marmota flaviventris flaviventris (Audubon & Bachman)	"Mountains between Texas and California"—fixed on Mount Hood, Oreg.
flaviventris avara (Bangs)	Okanogan, British Columbia.
flaviventris sierrae nobis	Mount Whitney, Cal.
flaviventris parvula Howell	Jefferson, Toquima Range, Nev.
flaviventris engelhardti Allen	Beaver Mountains, Utah.
flaviventris nosophora Howell	Willow Creek, 7 miles east of Corvallis, Mont.
flaviventris dacota (Merriam)	Custer, S. Dak.
flaviventris luteola Howell	Woods P. O., Medicine Bow Mountains, Wyo.
flaviventris warreni Howell	Crested Butte, Colo.
flaviventris obscura Howell	Wheeler Peak, N. Mex.
Marmota caligata group:	
Marmota caligata caligata (Eschscholtz)	Bristol Bay, Alaska.
caligata vigilis Heller	Glacier Bay, Alaska.
caligata sheldoni Howell	Montague Island, Alaska.
caligata oxytona Hollister	Head of Smoky River, Alberta.
caligata okanagana (King)	Gold Range, British Columbia.
caligata nivaria Howell	Mountains near St. Marys Lake, Mont.
caligata cascadensis Howell	Mount Rainier, Wash.
Marmota olympus (Merriam)	Olympic Mountains, Wash.
Marmota vancouverensis Swarth	Mount Douglas, Vancouver Island, British Columbia.

Key to American Species and Subspecies.

[Based on typical adults.]

- *a*. Upperparts mainly black and white (shaded with cinnamon-buff on rump).
  - *b*. Underparts mainly white.
    - *c*. Size small; condylo-basal length of ♀ skull less than 90 mm.... *sheldoni* (p. 62).
    - *c'*. Size large; condylo-basal length of ♀ skull more than 90 mm.
      - *d*. Skull shorter; condylo-basal length in ♀ less than 98 mm... *caligata* (p. 59).
      - *d'*. Skull longer; condylo-basal length in ♀ more than 98 mm.. *nivaria* (p. 66).
  - *b'*. Underparts dusky (blackish brown, soiled whitish, or clay color).
    - *c*. Skull relatively short and broad; condylo-basal length in ♂ less than 101 mm.; in ♀ less than 98 mm.
      - *d*. Nasals shorter, rarely extending back of posterior ends of premaxillae. *okanagana* (p. 64).
      - *d'*. Nasals longer, always extending back of posterior ends of premaxillae. *vigilis* (p. 61).
    - *c'*. Skull relatively long and narrow; condylo-basal length in ♂ more than 101 mm.; in ♀ more than 95 mm.
      - *d*. Upperparts whiter; skull relatively broader (ratio of zygomatic breadth to condylo-basal length 64–67)........................... *cascadensis* (p. 67).
      - *d'*. Upperparts blacker; skull relatively narrower (ratio of zygomatic breadth to condylo-basal length 62–64)......................... *oxytona* (p. 63).
- *a'*. Upperparts mainly brownish, yellowish, drab, or buffy.
  - *b*. Upperparts of solid colors (not grizzled).
    - *c*. Upperparts brownish drab, buffy, or russet.................. *olympus* (p. 69).
    - *c'*. Upperparts dark vandyke brown, blackish brown, or black.
      - *d*. Posterior border of nasals deeply emarginate; color dark vandyke brown. *vancouverensis* (p. 70).
      - *d'*. Posterior border of nasals not deeply emarginate; color blackish brown or black... *vigilis* (p. 61).
  - *b'*. Upperparts of mixed colors (grizzled).
    - *c*. Sides of neck with conspicuous buffy patches.
      - *d*. Underparts distinctly reddish.
        - *e*. Crown chestnut.. *warreni* (p. 52).
        - *e'*. Crown blackish brown.
          - *f*. Long hairs on fore back with a subterminal band of black or brown. *nosophora* (p. 46).
          - *f'*. Long hairs on fore back without a subterminal band of black or brown. *dacota* (p. 49).
      - *d'*. Underparts not distinctly reddish.
        - *e*. Size smaller; condylo-basal length of ♀ skull 71–80 mm.; of ♂ skull 85–87.[1]
          - *f*. Fore back with a distinct buffy mantle.
            - *g*. Underparts darker; size smaller..................... *parvula* (p. 44).
            - *g'*. Underparts paler; size larger........................... *avara* (p. 41).
          - *f'*. Fore back without a distinct buffy mantle.......... *engelhardti* (p. 45).
        - *e'*. Size larger; condylo-basal length of ♀ skull 77–90 mm.; of ♂ skull 84–97 mm.
          - *f*. Face markings and neck patches reduced............... *obscura* (p. 53).
          - *f'*. Face markings and neck patches prominent.
            - *g*. Hind feet darker (hazel or chestnut-brown)........... *luteola* (p. 50).
            - *g'*. Hind feet lighter (tawny to light buff).
              - *h*. Larger; condylo-basal length of ♂ skull more than 90 mm.; of ♀ more than 84 mm......................... *flaviventris* (p. 39).
              - *h'*. Smaller; condylo-basal length of ♂ skull less than 90 mm.; of ♀ less than 84 mm............................ *sierrae* (p. 43).

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[1] Adult male of *parvula* and *engelhardti* unknown.

c′. Sides of neck without conspicuous buffy patches.
  d. Tail cinnamon...*ochracea* (p. 34).
  d′. Tail dark brown or black.
    e. Colors pale (underfur on back light pinkish cinnamon to light gray at tips; belly not deep red).
      f. Skull larger; condylo-basal length more than 90 mm.....*monax* (p. 22).
      f′. Skull smaller; condylo-basal length less than 90 mm.*preblorum* (p. 27).
    e′. Colors dark (underfur on back pinkish cinnamon to orange-cinnamon at tips; belly deep red).
      f. Size smaller; condylo-basal length of ♂ skull less than 82 mm.; of ♀ less than 80 mm....................................*canadensis* (p. 30).
      f′. Size larger; condylo-basal length of ♂ skull more than 82 mm.; of ♀ more than 80 mm.
        g. Nasals relatively short and wide; width at posterior end in males more than 11 mm..................................*ignava* (p. 29).
        g′. Nasals relatively long and narrow; width at posterior end in males less than 11 mm.
          h. Size larger; nasals longer, extending considerably back of posterior end of premaxillae...............................*rufescens* (p. 25).
          h′. Size smaller; nasals shorter, extending little, if any, back of posterior end of premaxillae........................*petrensis* (p. 33).

DESCRIPTIONS OF AMERICAN SPECIES AND SUBSPECIES.

Marmota monax Group.

[Characters under species.]

MARMOTA MONAX (LINNAEUS).

[Synonymy under subspecies.]

External characters.—Size medium;[1] tail relatively short (about 20 to 25 per cent of total length); ears large; posterior pad on sole of hind foot oval in shape and situated near middle of sole (see Pl. III, fig. 3); mammae—P. $\frac{2}{2}$, A. $\frac{1}{1}$, I. $\frac{1}{1}=8$; head without white markings (except around nose); sides of neck same color as upperparts; feet black or dark brown; fore legs overlaid with deep reddish-colored hairs (hazel to burnt sienna); tail black, dark brown, or (in *ochracea*) pinkish cinnamon.

Cranial characters.—Skull with superior outline nearly straight, the occipital region slightly depressed and rostrum considerably but not abruptly depressed from about posterior border of premaxillae; braincase broad and noticeably flattened; interorbital region relatively broad; postorbital processes heavy, projecting nearly at right angles to axis of skull or slightly forward; width of nasals at posterior end usually decidedly greater than width of nasal branches of premaxillae; temporal ridges often not meeting in old age, or sometimes meeting but not united (rarely fused into a sagittal crest); floor of basi-occipital nearly flat, bordered on each side by low processes which converge posteriorly and sometimes meet near inferior lip of foramen magnum;

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[1] Audubon and Bachman give the weight of one as 9 pounds 11 ounces; a writer in Forest and Stream, LV, p. 424, gives the average weight of 158 as 10 pounds; heaviest, 13½ pounds.

palate abruptly truncated at posterior border; interpterygoid fossa relatively wide; palatal foramina contracted anteriorly; molar teeth heavy; maxillary tooth rows approximately parallel; anterior face of incisors yellowish white or ivory yellow to pale orange-yellow.

Color.—General tone of upperparts grayish- or reddish-brown, or (in *ochracea*) vinaceous-cinnamon, grizzled with white, light buff, or cinnamon-buff; underfur of upperparts at base dark mouse gray to blackish brown, succeeded by pallid neutral gray, light ochraceous-buff, pinkish-, vinaceous-, or orange-cinnamon; long hairs dark chestnut-brown, blackish brown, or (in *ochracea*) orange-cinnamon, tipped with light buff, pale ochraceous-buff, or white; top of head and face varying from dark hair-brown or benzo brown to vandyke- or clove-brown; sides of face light buff, ochraceous-buff, or white, mixed with brown; borders of nose, lips, and chin, white or buffy white; underparts buffy white, light ochraceous-buff, pinkish cinnamon, tawny, hazel, or burnt sienna, more or less varied with brown, the bases of hairs often blackish brown or black; fore legs and feet black, blackish brown, dark chestnut-brown, fuscous, or hazel (in *ochracea*), the legs and thighs (except in *ochracea*) overlaid with burnt sienna, Sanford's brown, or tawny; hind legs and feet similar, but thighs often paler, sometimes overlaid with pinkish cinnamon; tail black or blackish brown, vandyke- or clove-brown, or (in *ochracea*) pinkish cinnamon, more or less grizzled with buffy white or cinnamon-buff; ears drab-gray on both surfaces, often clothed with fuscous hairs.

Geographic distribution.—From eastern Alaska (Fortymile Creek), Great Slave Lake, York Factory (Hudson Bay), East Main and Hamilton Rivers, Quebec, south to northern Idaho in the Rocky Mountains, and east of the Great Plains to northern Arkansas, northern Alabama, and southern Virginia; west in the United States to eastern parts of North Dakota, Kansas, and Oklahoma. (See fig. 1.)

MARMOTA MONAX MONAX (LINNAEUS).

SOUTHERN WOODCHUCK.

(Pl. IV, fig. 2; Pl. V, fig. 1; Pl. XI, fig. 1.)

[*Mus*] *monax* Linnaeus, Syst. Nat., ed. 10, I, 1758, p. 60.
[*Glis*] *monax* Erxleben, Syst. Regn. Anim., 1777, p. 361.
Arctomys monax Schreber, Säugthiere, IV, 737, 1782; Plate CCVIII, 1780.
[*Marmota*] *monax* Trouessart, Cat. Mamm., Suppl., 1904, p. 344.

Type locality.—Maryland.

Distribution.—Middle eastern United States from Pennsylvania, New Jersey(?), Ohio, Indiana, Illinois, and Iowa, south to the northern parts of South Carolina, Georgia, Alabama, and Arkansas; west to eastern Kansas.

Characters.—Size large; colors pale, the underfur grayish white; underparts little, if any, darker than upperparts; skull massive.

Color.—General tone grayish brown above, with a faint buffy tinge; underfur blackish brown at base succeeded by pallid neutral gray, faintly (rarely strongly) tinged with light ochraceous-buff, strongest on hinder back; long hairs blackish brown, broadly tipped with white or buffy white; top of head and face varying from benzo brown to clove brown; sides of nose and borders of lips and chin buffy white; sides of face mixed brown and buffy white; feet and legs black or blackish brown (rarely fuscous or dark chestnut-brown), the hairs on legs tipped with tawny or hazel; tail blackish brown, sparingly

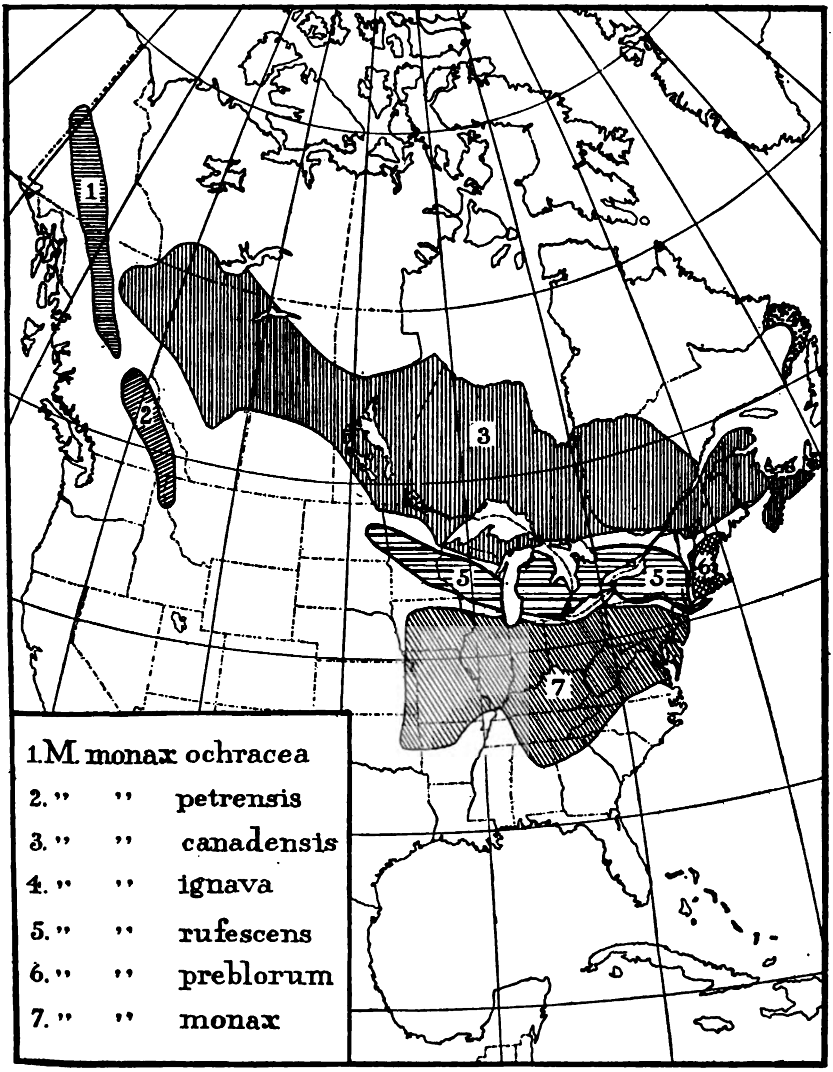

FIG. 1.—Distribution of the *Marmota monax* group. Unshaded areas within the range of the group indicate lack of definite knowledge as to the subspecies occurring there.

grizzled with buffy white; underparts buffy white or light ochraceous-buff, the bases of hairs blackish brown.

Skull.—Largest of the group; relatively long and narrow; sagittal crest well developed (in adults); interorbital region broad; nasals long and broad, usually squarely truncated posteriorly; premaxillae narrow; palate long, extending from 2 to 4 mm. behind plane of molars; palatal foramina rather narrow; interpterygoid fossa broad; audital bullae moderately inflated.

Measurements.—Adult male from Gunston, Va: Total length, 665; tail vertebrae, 153; hind foot, 88. Adult male from Sandy Spring, Md.: 573; 145; 82. Average of 4 adult females from District of Columbia and Virginia: 557; 139; 83. *Skull:* Adult male:[1] Condylobasal length, 97.3–102.5 (average 97.8); palatal length, 55–59.5 (57.4); postpalatal length, 34.5–37.7 (36.2); length of nasals, 39.7–41.8 (40.8); zygomatic breadth, 63–69.2 (65.9); breadth across mastoids, 44.5–50.2 (46.9); least interorbital breadth, 25–29.2 (27.1); breadth of rostrum, 20.6–23.7 (21.7); maxillary tooth row, 21–21.9 (21.3). Adult female:[2] Condylo-basal length, 90.4–91.8 (91.2); palatal length 50.2–56 (53.1); postpalatal length, 33.7–36.3 (34.9); length of nasals, 36.8–40.6 (38.7); zygomatic breadth, 59.5–62 (61.2); breadth across mastoids, 44–45.8 (44.7); least interorbital breadth, 23.5–26.5 (24.9); breadth of rostrum, 19.7–21.3 (20.5); maxillary tooth row, 20.5–22.4 (21.2).

Remarks.—The southern woodchuck is a rather large animal of massive skull and pale color. With a wide range in the Middle States, it grades into a smaller and darker form (*rufescens*) in the southern parts of New York, Michigan, and Wisconsin. Specimens from northern Illinois (Lake Forest and Willow Springs) and northern Indiana (Rose Lawn and Lake Maxinkuckee) are typical of *monax*, but those from Delavan, Wis., and southwestern Michigan are intermediate between *monax* and *rufescens*. Specimens from Marble Cave, Mo., and from Johnson County, Iowa, are typical, but a small series from the vicinity of Lawrence, Kans., seems to indicate the presence there of a large form, skulls of females, especially, being much larger than those of females from Maryland and Virginia and equaling in size skulls of males from that region. The hind feet also average about 16 per cent longer in the Kansas animal (3 specimens). Additional material from that region may require naming the form.

Specimens examined.—Total number, 75, as follows:

Alabama: Ardell, 3.
District of Columbia: Washington, 6.
Georgia: Young Harris, 1.

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[1] Six specimens from Maryland, Virginia, West Virginia, and Pennsylvania.

[2] Five specimens from Virginia, District of Columbia, and Pennsylvania.

Illinois: Cook County, 1; Lake Forest, 1;[1] Ozark, 2;[1] West Northfield, 1; Willow Springs, 1.[1]
Indiana: Lake Maxinkuckee, 1; Marion County, 1;[2] Rose Lawn, 1.
Iowa: Iowa City, 4;[3] Johnson County, 4;[3] Wall Lake, 1; no specific locality, 3.[3]
Kansas: Douglas County (near Lawrence), 6;[4] Lawrence, 3.[4]
Kentucky: Mammoth Cave, 1.
Maryland: Plummer Island, 2; Sandy Spring, 1; Simpsonville, 1; near Washington, D. C., 1.
Michigan: Cass County, 1;[5] Dowagiac, 1.[5]
Missouri: Marble Cave, 2.
North Carolina: Magnetic City (base of Roan Mountain), 7; Roan Mountain (altitude 3,000–4,000 feet), 5.
Ohio: Hicksville, 1.[1]
Pennsylvania: Beaver, 2;[6] Chester County, 3; Fair Oaks, 1;[6] Kennett Square, 1;[7] Landenberg, 1;[7] Marple, 1;[7] Meadville, 1; Round Island, Clinton County, 2.[7]
Tennessee: Dover, Stewart County, 1; Duck River, 6 miles southwest of Waverly, 2; Highcliff, 1.
Virginia: Bluemont, 1; Clarke County, 1; Doswell, 1; Fairfax County (Potomac River), 3; Fincastle, 1; Fredericksburg, 2; Gunston, 1; Peaks of Otter, 1; Washington, 2.
West Virginia: Franklin, 3; Jobs Knob, 1; North Mountain, Hardy County, 1; Rowleysburg, 1.

MARMOTA MONAX RUFESCENS Howell.

Rufescent Woodchuck.

(Pl. IV, fig. 5; Pl. V, fig. 2; Pl. XI, fig. 2.)

Marmota monax rufescens Howell, Proc. Biol. Soc. Washington, XXVII, 1914, p. 13.

Type locality.—Elk River, Minn.

Distribution.—Eastern North Dakota, central and southern Minnesota, Wisconsin, and Michigan, southern Ontario, greater part of New York (including Long Island), and higher parts of western Massachusetts.

Characters.—Similar to *monax* but colors much redder, both above and below, the underfur on back pinkish cinnamon instead of light buff; similar in color to *ignava*, but averaging paler; skull decidedly smaller than that of *monax*, but much larger than that of *canadensis*.

Color.—Underfur of upperparts varying from fuscous-black to dark mouse gray at base, succeeded by a broad area of light pinkish cinnamon shading to pinkish cinnamon on hinder back and to orange-cinnamon on hind legs; long hairs dark chestnut-brown subterminally, tipped with light buff; top of head and face benzo brown to clove brown; sides of face light buff, more or less mixed with brown; fore legs black, overlaid with burnt sienna; hind legs similar but usually less intensely red; feet black or blackish brown; tail vandyke brown to clove brown or black; underparts varying from burnt sienna to Sanford's brown, more or less mixed with tawny, ochraceous-buff, and black (general tone of under parts usually reddish but sometimes mixed brown and buff with little red); tail vandyke brown to clove brown or black. *Variation:* Specimen from Essex County, N.Y.: Very dark chestnut-brown above (the underfur pinkish cinnamon), moderately grizzled on fore back with buffy white; hinder back solid brown.

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[1] Collection Field Mus. Nat. Hist.
[2] Collection Amer. Mus. Nat. Hist.
[3] Collection Univ. of Iowa.
[4] Collection Kansas Univ. Mus.
[5] Collection Univ. of Michigan.
[6] Collection Carnegie Museum.
[7] Collection Acad. Nat. Sci. Philadelphia.

Skull.—Similar to that of *monax*, but decidedly smaller and relatively broader across zygomata; much larger than that of *canadensis;* slightly larger than that of *ignava*, but narrower across orbits and with narrower nasals.

Measurements.—Adult male:[1] Total length, 520–582 (average, 548); tail vertebrae, 135–155 (143); hind foot, 81–85 (83). Adult female:[2] Total length, 545–608 (571); tail vertebrae, 145–170 (156); hind foot, 83–89 (85). *Skull:* Adult male:[3] Condylo-basal length, 81.3–94.4 (88.6); palatal length, 50.7–54.5 (51.8); postpalatal length, 32–36.4 (33.5); length of nasals, 33.9–39.8 (36.8); zygomatic breadth, 53.4–64.7 (60.2); breadth across mastoids, 40.3–46 (43.2); least interorbital breadth, 21.7–25.4 (23.8); breadth of rostrum, 18–21.2 (19.4); maxillary tooth row, 18.7–21.8 (20.1). Adult female:[4] Condylo-basal length, 84–88.9 (85.8); palatal length, 49.1–52.4 (50.6); postpalatal length, 31.5–31.8 (31.6); length of nasals, 33.4–39.1 (35.6); zygomatic breadth, 57.5–62 (59.9); breadth across mastoids, 40.6–43.8 (42.4); least interorbital breadth, 22.2–26.3 (23.6); breadth of rostrum, 18.2–20.4 (19); maxillary tooth row, 17.5–21 (19.7).

Remarks.—The woodchucks of the Northern States, from Minnesota to New York, differ from typical *monax* of the Middle States in having smaller skulls and darker colors, the underfur especially being more strongly reddish. The race shows a strong tendency toward melanism, particularly in New York and southern Ontario. The New York series differs from the Minnesota series in somewhat longer and relatively narrower skulls, being, therefore, more like *monax*, but the differences between the two extremes are too slight and inconstant to warrant recognition of another form. Specimens from the Catskill Mountains are fairly typical of *rufescens*, but those from the Hudson Valley and Lake George are clearly intermediate, the skulls being almost typical of *monax* and the skins of *rufescens*. These show no approach to the New England form (*preblorum*). Two skulls (without skins) from Easthampton, Mass., are fairly typical of *rufescens*, indicating that this race probably occupies the higher parts of western Massachusetts. A specimen from Lake of Bays, Ontario (east side of Georgian Bay), considered intermediate between *rufescens* and *canadensis*, is very deep red below—fully as dark as *ignava*. The northern limit of the range of *rufescens* is assumed to be about the latitude of Ottawa, but no material is available from that part of Ontario, excepting the specimen mentioned above.

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[1] Five specimens from Elk River and Fort Snelling, Minn.

[2] Five specimens from Fort Snelling, Minn.

[3] Eleven specimens from Minnesota.

[4] Five specimens from Minnesota.

Specimens examined.—Total number, 231, as follows:

Massachusetts: Easthampton, 2.

Michigan: Ann Arbor, 3;[1] Au Sable River, Oscoda County, 1;[1] Genesee, 1; Rush Lake, Huron County, 1;[1] Sand Point, Huron County, 1.[1]

Minnesota: Elk River, 10; Fort Snelling, 17;[2] Princeton, 1.

New York: Adirondack Mountains, Essex County, 76 (skulls only); Ardsley, 1;[3] Amber, 2; Brantingham, 1; Croton Lake, 1; Dutchess County, 1;[3] Elizabethtown, 2; Essex County, 8; Halcottsville, 10;[4] Hastings, 1;[5] Highland Falls, 1; Lake George, 11; Leyden, 2; Locust Grove, 15; Lyons Falls, 5; Miller Place, 4;[4] Orange County, 1; Owego, 1; Oyster Bay, 2; Peterboro, 4; Piseco, 1; Schroon, 1; Schroon Lake, 4; Sing Sing, 4; Suffolk County, 2;[3,5] Troy, 3; Tupper Lake, 1;[6] Wells, 3; no specific locality, 7.

North Dakota: Fargo, 3;[7] Grafton, 1; Leonard, 1.[8]

Ontario: Lake of Bays, 1; Lorne Park, 7.

Wisconsin: Bridgeport, 1; Delavan, 2; Milton, 2;[9] Racine, 1.

MARMOTA MONAX PREBLORUM Howell.

NEW ENGLAND WOODCHUCK.

(Pl. III, fig. 3; Pl. V, fig. 3; Pl. XI, fig. 3.)

Marmota monax preblorum Howell, Proc. Biol. Soc. Washington, XXVII, 1914, p. 14.

Type locality.—Wilmington, Mass.

Distribution.—Southern New England, from Connecticut to central Vermont and New Hampshire and southern Maine.

Characters.—Size medium (smaller than *rufescens*, larger than *canadensis*); colors pale (redder than *monax*, but red not so dark as in *canadensis* or *rufescens*); skull smaller and relatively narrower than that of *rufescens*.

Color.—*Adult:* Underfur on upperparts pinkish cinnamon to light pinkish cinnamon, the bases of hairs fuscous-black; long hairs blackish brown, extensively tipped with white or light buff; top of head and face dark hair-brown to clove brown; sides of face light buff; fore legs burnt sienna or Sanford's brown, the bases of hairs often black; hind legs somewhat paler, shading to pinkish cinnamon; feet black or blackish brown; tail clove brown to black, much mixed with cinnamon; underparts pinkish cinnamon or Sanford's brown, varied with light buff. *Young* (specimen from Saunderstown, R. I.): General tone, both above and below, pinkish buff (the hairs extensively tipped with that color and the bases of same shade), becoming pinkish cinnamon on hinder back; subterminal band of each hair blackish brown; fore legs Sanford's brown; hind legs tawny; top of head hair-brown.

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[1] Collection Univ. of Michigan.

[2] Three in collection Field Mus. Nat. Hist.; five in Amer. Mus. Nat. Hist.

[3] Collection Amer. Mus. Nat. Hist.

[4] Collection A. H. Helme, Miller Place, N. Y.

[5] Collection Field Mus. Nat. Hist.

[6] Collection Mus. Comp. Zool.

[7] Two in collection Fargo College; one in N. Dak. Agr. College.

[8] Collection N. Dak. Agr. College.

[9] Collection H. H. T. Jackson, Washington, D. C.

Skull.—Similar to that of *rufescens*, but smaller and relatively narrower, especially the rostrum and interorbital region; bullae smaller; much larger than that of *canadensis*, with longer, slenderer rostrum and longer nasals.

Measurements.—Adult male:[1] Total length, 418–608 (average 515); tail vertebrae, 105–149 (120); hind foot, 75–80 (77.7). Adult female:[2] 465–600 (547); 100–157 (141); 69–88 (77). *Skull*: Adult male:[3] Condylo-basal length, 84–89 (86.2); palatal length, 49.9–51.6 (50.7); postpalatal length, 31.2–33.4 (32); length of nasals, 34.3–37.7 (35.9); zygomatic breadth, 57.3–60.4 (58.7); breadth across mastoids, 41.3–44.3 (42.8); least interorbital breadth, 20.7–22.5 (22.1); breadth of rostrum, 17.2–18.6 (18.2); maxillary tooth row, 18.2–20.2 (19.1). Adult female:[4] Condylo-basal length, 79.1–86.6 (83); palatal length, 47.7–51.6 (49.5); postpalatal length, 28–31.8 (30.1); length of nasals, 33.7–36.8 (35.6); zygomatic breadth 54–58 (56.6); breadth across mastoids, 37.7–42 (40.3); least interorbital breadth, 19.8–22.6 (21.6); breadth of rostrum, 16–19.5 (18); maxillary tooth row, 18–20.4 (19.3).

Remarks.—The New England woodchuck is noticeably smaller and paler than *rufescens*, and larger and paler beneath than *canadensis*. In skull characters it most resembles *rufescens* and probably intergrades with it where their ranges meet, but no intermediate specimens have been examined. A specimen from Liberty Hill, Conn., has somewhat redder underparts than the Massachusetts series, its skull being fairly typical of *preblorum*. Specimens of *rufescens* from the Hudson Valley, however, approach *monax* rather than *preblorum* in skull characters. Intergradation with *canadensis* also undoubtedly occurs, but material from northern New England is needed to show where the two forms come together. Specimens from Rutland, Vt., agree in skull characters with *preblorum*, but one of the two skins examined is somewhat redder below than in Massachusetts examples.

Specimens examined.—Total number, 38, as follows:

Connecticut: East Wallingford, 1;[5] Liberty Hill, 1.[6]
Maine: Eliot, 1; Norway, 1.[6]

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[1] Seven specimens from eastern Massachusetts.
[2] Nine specimens from eastern Massachusetts and southern New Hampshire.
[3] Five specimens from Wilmington and Wareham, Mass.
[4] Four specimens from Wilmington and Lunenburg, Mass.
[5] Collection Am. Mus. Nat. Hist.
[6] Collection Mus. Comp. Zool.

Massachusetts: Essex County, 1; Haverhill, 1;[1] Lunenburg, 4; Newtonville, 2;[1] Sherborn, 1; Springfield, 2;[1] Wareham, 2;[1] Wayland, 1;[1] Wilmington, 8; Woburn, 1.
New Hampshire: Charlestown, 2; Ossipee, 2; Webster, 3.[1]
Rhode Island: Saunderstown, 1.
Vermont: Rutland, 3.[2]

MARMOTA MONAX IGNAVA (BANGS).

LABRADOR WOODCHUCK.

(Pl. V, fig. 4; Pl. XII, fig. 1.)

Arctomys ignavus Bangs, Proc. New England Zool. Club, I, 1899, p. 13.
[*Arctomys monax*] *ignavus* Elliot, Synop. Mamm. N. Am., Field Columb. Mus., Zool. Ser., II, 1901, p. 105.
[*Marmota monax*] *ignavus* Trouessart, Cat. Mamm., Suppl., 1904, p. 344.
Marmota ignava Miller, Bul. 79, U. S. Nat. Mus., 1912, p. 292.

Type locality.—Black Bay, Straits of Belle Isle, Labrador.

Distribution.—Known only from vicinity of type locality; probably north to Hamilton Inlet.

Characters.—Size much larger than *canadensis*, nearly equaling *rufescens;* similar in color to *rufescens* (much darker than *canadensis*); skull short and broad with very broad nasals.

Color.—Underfur of upperparts blackish brown at base (a shade darker than in *canadensis*), succeeded by a broad area of orange-cinnamon; long hairs blackish brown subterminally, tipped with pale ochraceous-buff or buffy white; top of head and face vandyke brown or clove brown; sides of nose and borders of lips and chin buffy white; sides of face light ochraceous-buff more or less mixed with brown; feet and legs black, or very dark brown, the legs and thighs overlaid with burnt sienna; tail blackish brown, usually with little or no white grizzling; underparts burnt sienna mixed with black, varying to tawny and in some individuals more or less mixed with pinkish cinnamon or pale buff; in others, mixed blackish brown and buff below without any red.

Skull.—Similar to that of *rufescens*, but shorter and relatively broader; nasals shorter and relatively wider posteriorly; premaxillae averaging narrower; bullae smaller and less inflated; sagittal crest more prominent; incisors with numerous shallow longitudinal grooves on outer face. Compared with *preblorum:* Skull about same length, but relatively broader; rostrum broader; nasals shorter and broader posteriorly; molars heavier. Compared with *canadensis:* Skull much larger, with decidedly heavier sagittal crest and less inflated bullae.

Measurements.—Adult male:[3] Total length, 480–562 (average, 536); tail vertebrae, 111–155 (137); hind foot, 74–86 (80.8). Adult female:[1] 496–556 (528); 102–147 (126); 75–80 (78.6). *Skull:* Adult male:[1] Condylo-basal length, 82.5–87.4 (85.1); palatal length, 48.5–51.2 (50); postpalatal length, 30.6–33 (31.7); length of nasals, 31.5–35.6 (34.1); zygomatic breadth, 57.5–63.4 (60.5); breadth across mastoids, 40.6–44 (41.7); least interorbital breadth, 24–26.8 (25); breadth of rostrum, 18–20.3 (19.2); maxillary tooth row, 19.9–20.8 (20.4). Adult female:[1] Condylo-basal length, 79.7–84.4 (82.2); palatal length, 47–49.4 (48.2); postpalatal length, 29.2–31.7 (30.6); length of nasals, 31.3–34.2 (32.6); zygomatic breadth, 55.4–58.7 (57.1); breadth across mastoids, 39–41.5 (40.6); least interorbital breadth, 22.5–25 (23.8); breadth of rostrum, 17.6–19.7 (18.7); maxillary tooth row, 19–20.4 (19.9).

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[1] Collection Mus. Comp. Zool.
[2] Collection Amer. Mus. Nat. Hist.
[3] Seven specimens from vicinity of type locality.

Remarks.—The Labrador woodchuck is a strongly marked form of the *monax* group, much larger and darker than *canadensis*, its nearest neighbor. Indeed, it might be considered a distinct species were it not practically certain that the ranges of *ignava* and *canadensis* are contiguous and that more material from the region between Murray Bay and the Straits of Belle Isle would show intergradation. In color and size the present form more closely resembles *rufescens* than *canadensis* and the skull is more like that of *preblorum* than that of any other form, but *ignava* is much darker than *preblorum*. The subspecies is reported to be common on the coast in the vicinity of Black Bay, and is said to be found about the head of Hamilton Inlet,[2] but the limits of its range are not known. Stearns reports woodchucks "common at Mingan, growing scarce toward Bonne Esperance."[3]

Specimens examined.—Total number, 15, as follows:

Labrador:[4] Ailik, Peter's Cove, 1; Black Bay, 4; L'Anse au Loup, 10.

MARMOTA MONAX CANADENSIS (ERXLEBEN).

CANADA WOODCHUCK.

(Pl. VI, fig. 1; Pl. XI, fig. 4.)

[*Glis*] *canadensis* Erxleben, Syst. Regn. Anim., 1777, p. 363.
Mus empetra Pallas, Nov. Spec. Quad., Glir. Ord., 1778, p. 75.
Arctomys sibila Wolf, Linne's Natursyst., II, 1808, p. 481. (Name proposed to include *Arctomys empetra* Pallas and *Arctomys pruinosa* Gmelin, supposed to be the same).
Arctomys melanopus Kuhl, Beiträge, 1820, p. 64.
Arctomys marmota canadensis Kuhl, Beiträge, 1820, p. 64.
Arctomys empetra Sabine, Trans. Linn. Soc. London, XIII, 1822, p. 584; Richardson, Fauna Boreali-Americana, I, 1829, p. 147.
Arctomys monax melanopus Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1897, p. 30.
Arctomys monax canadensis Allen, Bul. Amer. Mus. Nat. Hist., X, 1898, p. 456.
[*Marmota monax*] *canadensis* Trouessart, Cat. Mamm., Suppl., 1904, p. 344.

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[1] Six specimens from vicinity of type locality.
[2] Low, A. P. Ann. Rept. Geol. Surv. Canada, VIII, 1895 (1897), p. 320L.
[3] Stearns, W. A. Proc. U. S. Nat. Mus., VI, 1883, p. 115.
[4] All in collection Mus. Comp. Zool.

Type locality.—"Canada et ad fretum Hudsonis"—here fixed at Quebec, Quebec.

Distribution.—Greater part of interior of Canada, from Great Slave Lake and York Factory south to southern Alberta (Red Deer), central Saskatchewan (Cumberland House), northern Minnesota, northern Wisconsin, northern Michigan, central Ontario, southern Quebec, New Brunswick, and Nova Scotia; northern and eastern limits of range in Quebec unknown.

Characters.—Size small; sexes about same size; colors strongly reddish, above and below; skull small without pronounced sagittal crest.

Color.—Underfur on upperparts blackish brown at base, succeeded by pinkish cinnamon or light pinkish cinnamon; long hairs blackish brown subterminally, tipped with white or pinkish buff; top of head and face hair-brown, sometimes shading to clove brown; sides of face light buff; feet and legs black, blackish brown, or fuscous, the legs and thighs overlaid with burnt sienna; tail blackish brown, considerably grizzled with cinnamon-buff or light buff; underparts deep tawny or burnt sienna sometimes varied with buff and moderately mixed with black. Melanistic specimens are rarely found, but one from Aitkin, Minn., is glossy blackish brown all over.

Skull.—Smallest of any member of the group; shorter and relatively broader than that of *preblorum*, with short, broad rostrum; much smaller than that of *ignava*, with sagittal crest only slightly developed; nasals narrowed posteriorly; bullae relatively large, smoothly rounded, and considerably inflated.

Measurements.—Adult male: Total length, 510–515 (average 513); tail vertebrae, 108–109 (108.5); hind foot, 74–78 (76);[1] average of three adult males from Mackenzie and Alberta: 500; 124; 75. Adult female:[2] 508–560 (536); 131–140 (136); 69–76 (73). *Skull:* Adult male:[3] Condylo-basal length, 75–80.8 (78.1); palatal length, 43.7–48.2 (45.7); postpalatal length, 27.5–29.6 (28.7); length of nasals, 29.9–32 (31.3); zygomatic breadth, 53–56.6 (54.1); breadth across mastoids, 36.4–39.4 (38); least interorbital breadth, 18.4–22.7 (20.7); breadth of rostrum, 15.1–18 (16.6); maxillary tooth row, 18.2–19.3 (18.8). Adult female:[4] Condylo-basal length, 77.4–80 (78.9); palatal length 45.6–47.2 (46.2); postpalatal length, 28.2–30.5 (29.3); length of nasals, 30.5–34.5 (32.6); zygomatic breadth, 52.8–58.2 (54.8); breadth across mastoids, 36.5–39.8 (37.8); least interorbital breadth, 19.8–22 (20.9); breadth of rostrum, 14.5–17.8 (16.3); maxillary tooth row, 18.1–19.2 (18.6).

Remarks.—The Canada woodchuck has the most extensive distribution of any of the American forms and over the greater part of its range shows comparatively little variation. Although markedly smaller than *rufescens* it intergrades with that form wherever their ranges meet, intermediate examples having been examined from Tower and Two Harbors, Minn., and Lake of Bays, Ontario. Intergradation with *ignava* seems highly probable, though not shown by the material in hand. Murray Bay specimens have very much smaller skulls than typical *ignava* from the Labrador coast, and no specimens have been examined from the intervening region. Two specimens from Nova Scotia show slight approach to *ignava*, the skins being the same color except that the bases of the hairs on the back are browner. The skull of one of these specimens is typical of *canadensis*, the other is a little larger, with somewhat broader nasals and a well-marked sagittal crest.

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[1] Two specimens from Murray Bay, Quebec.

[2] Three specimens from Quebec and Ontario.

[3] Eight specimens from Mackenzie, Alberta, Manitoba, Quebec, Nova Scotia, and northern Wisconsin.

[4] Seven specimens from Mackenzie, Manitoba, Ontario, Nova Scotia, and Quebec.

A specimen from Porcupine Mountains, Mich., resembles *canadensis* in general coloration, but is extensively mixed with black both above and below. Its skull is slightly longer than skulls of typical specimens from Quebec. A specimen from Mount Mansfield, Vt., and one from Columbia Falls, Me., (both without skulls), are provisionally referred to *canadensis*, the former agreeing in color with the typical form, the latter with the dark Nova Scotia form. Specimens from southern Mackenzie and northern Alberta are practically identical in coloration with the Quebec series, but their skulls average longer and narrower, thus showing approach to *ochracea*. A single young specimen in very worn pelage from near the head of Finlay River, British Columbia, seems referable to *canadensis*, but more material from that region may necessitate its reference to *ochracea*. Woodchucks of this group are reported by Edward A. Preble as occurring at Fort Grahame, on Finlay River, and at Hudson's Hope.

Specimens examined.—Total number, 45, as follows:

Alberta: Athabaska River (near Fort McMurray), 1; McLeod River, 1; Peace River Landing, 2;[1] Red Deer, 1;[2] South Edmonton, 1.
British Columbia: Finlay River (near head), 1.
Mackenzie: Fort Liard, 1; Fort Simpson, 5; Little Buffalo River, 1.
Maine: Columbia Falls, 1.
Manitoba: Oxford House, 1; Trout Lake, 4; York Factory, 1.
Michigan: Porcupine Mountains, 1;[3] Whitefish Point, Chippewa County, 1.[3]
Minnesota: Aitkin, 1;[2] Tower, 1; Two Harbors, 1.
New Brunswick: Arthurette, 2;[4] Scotch Lake, 1.
North Dakota: Pembina, 1.
Nova Scotia: Newport, 2.[4]
Ontario: Devils Portage, Mattagami River, 1;[5] James Bay, 1; Moose River (near Hudson Bay) 2.[4]
Quebec: Murray Bay, 7.[2]
Vermont: Mount Mansfield, 1.
Wisconsin: Conover, 1.[2]

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[1] Collection Victoria Mem. Mus.
[2] Collection Field Mus. Nat. Hist.
[3] Collection Univ. of Michigan.
[4] Collection Amer. Mus. Nat. Hist.
[5] Collection Carnegie Mus.

MARMOTA MONAX PETRENSIS SUBSP. NOV.

BRITISH COLUMBIA WOODCHUCK.

(Pl. VI, fig. 2.)

Type from Revelstoke, British Columbia. Adult ♂, No. 203532, U. S. Nat. Mus., Biological Survey collection. Collected May 12, 1890, by W. Spreadborough; original number, 170.

Distribution.—Interior ranges of southern British Columbia and adjacent parts of United States, from Barkerville, British Columbia, south to Thompson Pass, Idaho.

Characters.—Similar to *canadensis*, but skull larger and relatively longer.

Color.—Practically the same as *canadensis*.

Skull.—Similar to that of *canadensis*, but larger and relatively longer; nasals rather short, projecting but little back of posterior ends of premaxillae; bullae rather small. Compared with *rufescens:* Smaller with shorter nasals and smaller, rounder bullae.

Measurements.—Adult male (type):[1] Total length, 540; tail vertebrae, 127; hind foot, 76; specimen from Barkerville, British Columbia: 460; 106; 72. Adult female (specimen from Barkerville, British Columbia): 505; 125; 68. *Skull:* Adult male (type): Condylo-basal length, 86; palatal length, 50.3; postpalatal length, 31.8; length of nasals, 32.5; zygomatic breadth, 57.4; breadth across mastoids, 42; least interorbital breadth, 23; breadth of rostrum, 18.6; maxillary tooth row, 20. Adult female (specimen from Barkerville, British Columbia): Condylo-basal length, 79; palatal length, 46.5; postpalatal length, 29.5; length of nasals, 32.4; zygomatic breadth, 53.2; breadth across mastoids, 36; least interorbital breadth, 19.4; breadth of rostrum, 17.6; maxillary tooth row, 18.8.

Remarks.—This is a slightly differentiated form of *monax*, occupying an area somewhat segregated from the rest of the species. It is known at present from only a few specimens and the limits of its range can not definitely be determined. It probably occurs sparingly throughout the heavily timbered mountain sides of the northern Rocky Mountains in Montana, Idaho, and British Columbia, but whether confined entirely to the west slope or not (as seems probable) has not yet been ascertained. This subspecies has no direct connection with *monax* or *rufescens*, its range being separated from theirs by an extensive area of plains, but it undoubtedly intergrades with *ochracea* on the north and possibly with *canadensis* through some of the passes of the mountains in southern British Columbia.

Specimens examined.—Total number, 6, as follows:

British Columbia: Barkerville, 2; Glacier, 2; Revelstoke, 1.
Idaho: Thompson Pass, 1.

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[1] From dry skin.

MARMOTA MONAX OCHRACEA Swarth.

Ochraceous Woodchuck.

(Pl. VI, fig. 3; Pl. XII, fig. 3.)

Marmota ochracea Swarth, Univ. of California Pub. Zool., VII, 1911, p. 203.

Type locality.—Head of Fortymile Creek, Alaska.

Distribution.—Interior mountain ranges of Yukon and northern British Columbia, from Fortymile Creek south to the Babine Mountains (and Stuart Lake?).

Characters.—Similar to *canadensis*, but paler below and hairs on back extensively tipped with ochraceous, the underfur more vinaceous; tail pinkish cinnamon all around; skull longer and relatively narrower.

Color.—Underfur of upperparts dark mouse gray at base, succeeded by a broad area of vinaceous-cinnamon, the latter shading toward the tips into orange-cinnamon, most intense on hinder back; long hairs orange-cinnamon, then blackish brown, broadly tipped on fore back with ochraceous-buff and on hinder back with light ochraceous-buff; top of head dark hair-brown; sides of nose and face light ochraceous-buff; underparts tawny shading to hazel; legs hazel; feet fuscous or fuscous-black with scattering hazel hairs; tail pinkish cinnamon all around, the tip clove brown. *Variation:* Young specimen from type locality: Darker below than adult, and feet more varied with hazel. Immature specimen from Pike River, British Columbia: Upperparts cinnamon (without plumbeous bases to the hairs), tipped with pinkish buff; underparts cinnamon-rufous.

Skull.[1]—Longer and relatively narrower than that of *canadensis*, with narrower rostrum and interorbital region; bullae broader.

Measurements.[2]—*Skull:* Subadult (male?) from Babine Mountains, British Columbia: Condylo-basal length, 81.2; palatal length, 48; postpalatal length, 30; length of nasals, 33.4; zygomatic breadth, 52.7; breadth across mastoids, 39.8; least interorbital breadth, 19.8; breadth of rostrum, 17.2; maxillary tooth row, 20.

Remarks.—This subspecies is the most northerly ranging member of the group. It occurs west of the continental divide in Yukon and northern British Columbia, but the limits of its range are not known. Only six skins have been seen. A specimen from near Teslin Lake, southern Yukon, is slightly darker below than the type (being uniform kaiser brown); the fore back is darker ochraceous, and the head blackish brown. Another specimen from Pike River, British Columbia, is dark blackish brown all over. A series of skulls without skins from Stuart Lake, British Columbia, is provisionally referred to this race.

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[1] No skulls from the type region available; description based on subadult specimen from Babine Mountains, British Columbia.

[2] No external measurements available.

Specimens examined.—Total number, 15, as follows:

Alaska: Fortymile Creek (at head), 2.[1]

British Columbia: Babine Mountains, 1 (skull); Pike River, Atlin, 2;[2] Stuart Lake, 8 (skulls); Tacla Lake, 1.

Yukon: Thirty Mile Mountains, near Teslin Lake, 1.[3]

Cranial Measurements of the Marmota monax Group.

No.	Species and locality.	Sex.	Condylo-basal length.	Palatal length.	Postpalatal length.	Length of nasals.	Zygomatic breadth.	Breadth across mastoids.	Least interorbital breadth.	Breadth of rostrum.	Maxillary tooth row.	Remarks.
	Marmota monax monax.											
114009	Montgomery Co., Md	♂	102.5	59.5	37.7	41.5	69.2	50.2	27.3	23.7	21.9	Old.
175010	Plummers Island, Md	♂	97.5	56.7	37	41.8	66	46.5	25.9	21.2	21.2	Adult.
143962	Peaks of Otter, Va	♂	98.1	58.1	36	40.5	65.7	47.2	27.2	20.7	21.2	Do.
58695	Roan Mountain, N. C	♂	94	57.3	32.6	38.7	....	42.9	24.4	19.5	21.6	Do.
[4] 447	Douglas County, Kans	♂	98.7	58.8	36.5	43	....	45.7	27.2	19.7	20.6	Subadult.
125331	Bluemont, Va	♀	93.7	56	35.3	40.6	61.9	45.8	26.5	19.9	21.2	Adult.
77926	Washington, D. C	♀	90.4	53.4	33.7	38	59.5	44.3	23.5	21.3	20.5	Do.
[4] 441	Douglas County, Kans	♀	100.6	58.7	37.8	43	66.7	49.2	28.4	21.8	21.8	Do.
[4] 448	.....do	♀	95.8	56.3	35.4	43	67.3	48.5	29	23.2	21.9	Do.
[5] 16029	Lake Forest, Ill	♀	92	54	34.2	38.6	62.7	46.4	26	22.5	21.6	Do.
	Marmota monax rufescens.											
186521	Elk River, Minn	♂	87.2	50.9	32	35.5	64.7	45.1	24.2	18.7	20.4	Adult; type.
191338	.....do	♂	89.8	52.2	34	37	59.8	43.4	23.5	20.5	20.9	Adult.
[6] 3508	Fort Snelling, Minn	♂	90.7	53.6	34.4	39.8	63.2	42.8	25.3	18.6	21.8	Do.
[6] 1780	.....do	♂	94.4	54.5	36.4	36	61.7	44	25.4	21.1	19	Do.
191244	Locust Grove, N. Y	♂	90	53.2	32.2	36.5	64.5	44	25.5	21	20.6	Do.
(7)	Adirondack Mountains, N. Y	♂	91.6	54.2	33.7	38.4	61.4	44.1	24.4	19.8	20.8	Do.
191339	Elk River, Minn	♀	84.2	49.1	31.5	34.5	57.5	40.6	22.5	18.3	20	Do.
35361	Fort Snelling, Minn	♀	87 8	52.4	31.8	39.1	62	43.8	23.7	20.4	21	Do.
122207	.....do	♀	84	50.3	31.5	33.4	59.2	42	20.3	20	17.5	Do.
191250	Locust Grove, N. Y	♀	86.3	51	32.5	37.8	60	42	21.8	17.5	20.2	Do.
(8)	Adirondack Mountains, N. Y	♀	86.8	51.4	31.2	37.1	59.8	41.9	23.5	19.2	20.2	Do.
111091	Peterboro, N. Y	♀	85	50.3	31.2	35.7	59.4	42	22.8	19.5	20.3	Do.
	Marmota monax preblorum.											
78360	Wilmington, Mass	♂	85.3	50.5	32	34.8	57.4	43.7	22.8	18.5	18.2	Adult; type.
78354	.....do	♂	86.1	51.5	31.2	36.3	58.2	42.7	22.5	17.2	18.3	Adult.
78355	.....do	♂	84	49.9	31.2	36.2	57.3	41.3	20.7	18.2	19.5	Do.
77111	Ossipee, N. H	♂	85.4	49.7	31.6	36	60.4	43.6	23	19.5	18.9	Do.
[6] 8235	Rutland, Vt	♂	85	50.5	31	37.5	58	42.2	23.5	18.5	20.5	Do.
78356	Wilmington, Mass	♀	79.1	47.7	28	33.7	54	37.7	19.8	16	18	Do.
78359	.....do	♀	84.8	49.9	31.8	36.8	57.8	40	22.6	18.1	19	Do.
96083	Lunenburg, Mass	♀	86.6	51.6	30.7	36.5	56.7	42	21.4	19.5	20.4	Do.
96142	.....do	♀	81.6	48.7	30	35.3	58	41.5	22.6	18.3	19.6	Do.
	Marmota monax ignava.											
[9] 8871	L'Anse au Loup, Labrador	♂	87.4	51.2	32.5	35.5	63.4	41.7	26.8	19.7	20.8	Adult.
[9] 8872	.....do	♂	82.7	48.7	31	33.2	59	41.2	24.3	18.5	20	Do.
[9] 8873	.....do	♂	86.5	51	32	35.4	60.5	42	24	20.3	20.7	Do.
[9] 8876	.....do	♀	84.4	49.1	31.7	33.6	58.7	41.3	25	19.7	19	Do.
[9] 8875	.....do	♀	84	49.4	30.6	34.2	58.6	41.5	24.3	18.8	19.6	Do.
[9] 7968	Black Bay, Labrador	♀	80.6	47.7	29.7	31.5	55.8	40	23	17.6	19.5	Do.
	Marmota monax canadensis.											
[5] 7607	Murray Bay, Quebec	♂	77.3	44	29.6	30.5	56.6	39.4	22.7	17.4	19.1	Adult.
[5] 7603	.....do	♂	75	43.7	28.8	32	53.2	36.4	21.7	16	18.7	Do.
[6] 16209	Newport, Nova Scotia	♂	76.4	44.5	28.7	32	53	38.2	20.5	15.8	18.6	Subadult.
191344	Carberry, Manitoba	♂	79.2	46.3	27.5	31.7	....	36.5	20.5	15.1	19	Adult.
177740	Smith Portage, Mackenzie	♂	78.3	45.8	28.6	31	53.3	38	20.5	17.2	18.3	Do.
[5] 7602	Murray Bay, Quebec	♀	77.6	45.6	28.8	33.5	56.6	38	22	17.8	19	Do.
[6] 7608	.....do	♀	78.7	46	29.6	32	53.2	39	20.4	17.1	18.4	Subadult.
110192	Oxford House, Manitoba	♀	79.7	47	28.4	33.3	54.7	37.2	21.1	15.9	18.7	Adult.
177378	Little Buffalo River, Mackenzie	♀	80	47.2	30.5	31.3	52.8	37.3	19.8	16.6	18.1	Do.
[6] 16208	Newport, Nova Scotia	♀	79.6	46	30.3	33.3	58.2	39.8	22	17.2	19.2	Do.

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[1] Collection Mus. Vert. Zool., Univ. of California.

[2] Collection Provincial Mus., Victoria, B. C.

[3] Collection Victoria Mem. Mus.

[4] Collection Kansas Univ. Mus.

[5] Collection Field Mus. Nat. Hist.

[6] Collection Amer. Mus. Nat. Hist.

[7] Average of 10 adults, Merriam collection.

[8] Average of 7 adults, Merriam collection.

[9] Collection Mus. Comp. Zool.

Cranial measurements of the Marmota monax group—Continued.

No.	Species and locality.	Sex.	Condylo-basal length.	Palatal length.	Postpalatal length.	Length of nasals.	Zygomatic breadth.	Breadth across mastoids.	Least interorbital breadth.	Breadth of rostrum.	Maxillary tooth row.	Remarks.
	Marmota monax petrensis.											
203532	Revelstoke, British Columbia....	♂	86	50.3	31.8	32.5	57.4	42	23	18.6	20	Adult; type.
101295	Barkerville, British Columbia..	♀	79	46.5	29.5	32.4	53.2	36	19.4	17.6	18.8	Adult.
	Marmota monax ochracea.											
202785	Babine Mountains, British Columbia........................	[♂?]	81.2	48	30	33.4	52.7	39.8	19.8	17.2	20	Subadult.
77143	Stuart Lake, British Columbia..	♂	80.6	47.6	29.5	30.6	55.6	38.2	20.6	18.8	19	Adult.
77141	.....do..........................	[♂?]	80.2	47.3	30.5	32.4	....	38.1	19.8	17.2	17.6	Do.
77137	.....do..........................	[♀?]	76.5	45	28.9	32.4	52	36.7	22	16.8	18.6	Do.
77140	.....do..........................	[♀?]	77.1	45.4	29.3	31.4	51.3	36.2	19.6	17.4	....	Do.

Marmota flaviventris Group.

[Characters under species.]

MARMOTA FLAVIVENTRIS (AUDUBON & BACHMAN).

[Synonymy under subspecies.]

External characters.—Size variable (small to medium);[1] tail relatively long (about 25 to 30 per cent of total length); ears small; sole pads as in the *monax* group (see Pl. III, fig. 2); mammae: P. $\frac{2}{2}$; A. $\frac{2}{2}$; I. $\frac{1}{1}=10$; head usually with white markings between eyes (absent or reduced in *obscura*); sides of neck with conspicuous buffy patches; feet varying from light buff to hazel or dark brown (never black); tail mixed hazel and dark brown (fading to clay color).

Cranial characters.—Skull similar in general outline to that of *monax*; interorbital region relatively narrower; postorbital processes longer and slenderer, projecting slightly back of a line drawn across their bases at right angles to axis of skull; nasals decidedly narrowed posteriorly, where their width is equal to or less than that of nasal branches of premaxillae; temporal ridges usually united in old age to form a well-defined but rather low sagittal crest; floor of basi-occipital with a median subcircular depression, bounded laterally by two low processes which converge and unite into a ridge near the inferior lip of the foramen magnum; posterior border of palate beveled at an obtuse angle; interpterygoid fossa relatively narrow; palatal foramina usually contracted posteriorly or of equal width throughout; molar teeth light; maxillary tooth rows slightly divergent anteriorly; anterior face of incisors yellowish white to zinc orange.

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[1] Two adult male specimens of *M. flaviventris nosophora* weighed, respectively, 10 and 12 pounds; two adult males of *M. flaviventris dacota*, 8 and 17 pounds, the latter being very fat.

Color.—General tone of upperparts vinaceous- or orange-cinnamon, hazel, chestnut-brown, or vandyke brown; underfur of upperparts at base mouse gray, fuscous, bister, clove brown, or blackish brown, succeeded by pinkish-, ochraceous-, or cinnamon-buff, pinkish-, vinaceous-, or orange-cinnamon, cartridge- or tilleul-buff, buffy white, hazel, or pale russet; long hairs chestnut-brown, olive-brown, hazel, or black, tipped with light buff, ochraceous- or cinnamon-buff, or white; top of head and face cinnamon-drab, chestnut, bay, chestnut-, vandyke-, or clove-brown, or black; sides of face chestnut-brown or blackish brown, more or less mixed with white or buff; face usually more or less extensively marked with a band or patch of white or buff between the eyes (nearly obsolete in *obscura*); borders of nose, lips, and chin white or ochraceous-buff; sides of neck usually with conspicuous patches of ochraceous-buff or cinnamon-buff (nearly obsolete in *obscura*); underparts ochraceous-buff, ochraceous-tawny, hazel, chestnut-, kaiser-, or blackish-brown, often varied with russet, Sanford's brown, tawny, or pale buff; fore legs ochraceous-buff, tawny, hazel, russet, or kaiser brown, the feet chestnut-brown, russet, auburn, pinkish cinnamon, or cinnamon-buff; hind legs ochraceous-buff, tawny, or hazel (rarely brownish), the feet varying from light buff or pinkish cinnamon to russet, hazel, chestnut-brown, or blackish brown; tail above, hazel, tawny, chestnut-brown, blackish brown, or (in faded pelage) clay color; beneath, blackish brown or chestnut-brown; ears usually some shade of buff, bordered with dark brown.

Geographic distribution.—From the interior valleys of southern British Columbia south in the Great Basin to the Toyabe Mountains, Nev., and Parawan Mountains, Utah; in the Cascade-Sierra system, from Mount Hood, Oreg., to vicinity of Owens Lake, Cal.; and in the Rocky Mountain system, from Flathead Lake, Mont., to the Pecos River Mountains, N. Mex.;[1] east to the Black Hills, S. Dak.; confined to mountains, foothills, and rocky canyons, not occurring on the plains proper. (See fig. 2.)

Remarks.—*Marmota flaviventris* usually may be readily distinguished from *M. monax* by the more ochraceous coloration, by the buffy, hazel, or tawny legs and feet (the latter usually black or blackish brown in *monax*), and by the presence of white or buffy face markings; occasional specimens of *M. flaviventris obscura* and *M. flaviventris luteola* rather closely resemble certain specimens of the *monax* group, but always lack the deep reddish hairs on the fore legs.

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[1] Formerly to the Manzano and Datil Mountains (vicinity of Old Fort Tularosa).

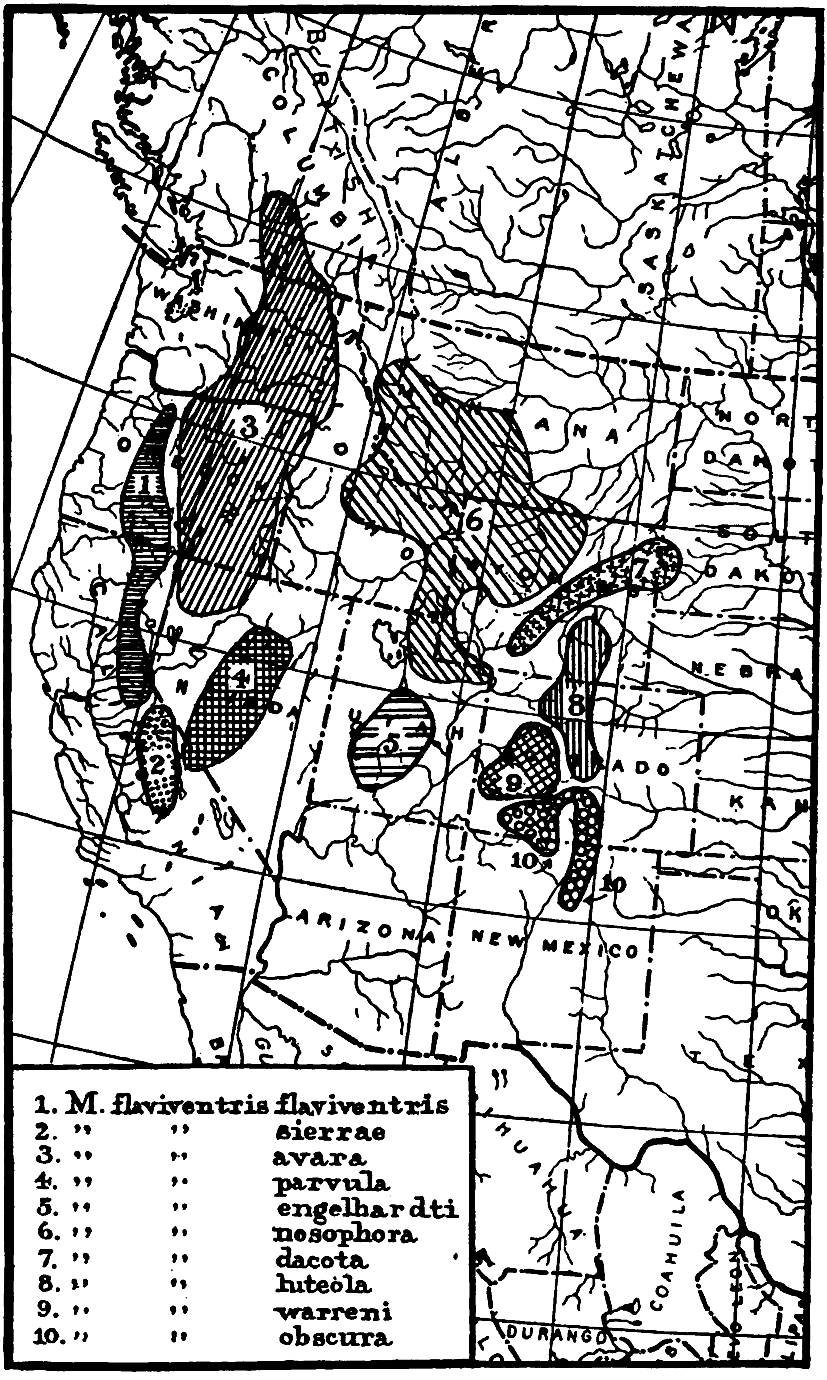

Fig. 2.—Distribution of the *Marmota flaviventris* group. Unshaded areas within the range of the group indicate a lack of definite knowledge as to the subspecies occurring there.

MARMOTA FLAVIVENTRIS FLAVIVENTRIS (AUDUBON & BACHMAN).

YELLOW-BELLIED MARMOT.

(Pl. III, fig. 2; Pl. VII, fig. 1; Pl. XIII, fig. 1.)

Arctomys flaviventer Audubon & Bachman, Proc. Acad. Nat. Sci. Philadelphia, 1841, p. 99; Quad. N. Am., III, 1853, p. 160, Pl. CXXXIV.

[*Marmota*] *flaviventer* Trouessart, Cat. Mamm. Suppl., 1904, p. 344.

Type locality.—"Mountains between Texas and California"—here fixed on Mount Hood, Oreg. (See remarks following, p. 40.)

Distribution.—The Cascade Range in Oregon and the northern Sierra in California, south to Lake Tahoe.

Characters.—Size large; general tone of upperparts russet, grizzled with white, the fore back sometimes overlaid with a rather indistinct buffy mantle; underparts ochraceous-buff to hazel; feet ochraceous or hazel; skull massive.

Color.—Underfur of upperparts deep mouse gray at base, succeeded by a broad area of buffy white, the latter shading on hinder back to pinkish cinnamon (sometimes to hazel); long hairs chestnut-brown or clove brown subterminally, tipped on fore back with light buff, on hinder back with white; top of head and face chestnut-brown to blackish brown, sometimes varied with cinnamon-drab, with an indistinct band of buffy white or ochraceous-buff across face in front of eyes; sides of face mixed chestnut-brown and cinnamon-buff; sides of neck with large patches of light ochraceous-buff; fore legs and feet tawny to hazel; hind feet light ochraceous-buff more or less varied with light hazel; tail hazel (fading to clay color), the bases of the hairs and under surface natal brown, varying to chestnut-brown or blackish brown; underparts ochraceous-buff, varying to hazel, becoming light ochraceous-buff around base of tail, the bases of some of the hairs indistinctly chestnut-brown; sides of nose, lips, and chin white, often varied with ochraceous-tawny around nose and edged with hazel or kaiser brown on throat.

Skull.—Largest of any member of the group; relatively long and narrow; nasals long, and narrow posteriorly; nasal branches of premaxillae broad; postorbital constriction broad; rostrum long and narrow; palatal foramina narrow.

Measurements.—Adult male from Donner, Cal.: Total length, 700; tail vertebrae, 180; hind foot, 90. Adult female from Crater Lake, Oreg.: 640; 170; 80. Adult female from Donner, Cal.: 600; 170; 85. *Skull:* Adult male:[1] Condylo-basal length, 92.5–97.1 (average 94.5); palatal length, 52.3–55 (53.8); postpalatal length, 37.6–38.2 (37.9); length of nasals, 42.5–42.6; zygomatic breadth, 62.3; breadth across mastoids, 41.1–46.2 (43.9); least interorbital breadth, 21.2–23 (22.1); breadth of rostrum, 22.3–23 (22.8); maxillary tooth row, 19.5–

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[1] Three specimens from Mount Hood, Oreg., and Fort Crook and Donner, Cal.

20.9 (20.1). Adult female:[1] Condylo-basal length, 82–87 (84.2); palatal length, 45.8–48.7 (47.6); postpalatal length, 30.6–34.5 (34.1); length of nasals, 34.5–37.2 (35.9); zygomatic breadth, 54.4–58.4 (55.9); breadth across mastoids, 38.5–40.7 (39.8); least interorbital breadth, 17.3–19.3 (18.5); breadth of rostrum, 17.8–21.4 (19.8); maxillary tooth row, 19.5–22.1 (20.5).

Remarks.—This species was described in 1841 and the name has been in use ever since in a broad sense for the marmots of the Sierra-Cascade range and, by most authors, for the Rocky Mountain forms as well. The original describers' statement as to the source of the type specimen—"mountains between Texas and California"—is not only too indefinite to be of use, but the evidence points to its being incorrect. The type specimen, as stated by Audubon and Bachman, was obtained by David Douglass and (the skin only) is still in a fair state of preservation in the British Museum, but unfortunately is unaccompanied by data to show where it was collected. Douglass's journal has been published,[2] and from it we learn that he spent a considerable time at Fort Vancouver near the mouth of the Columbia River, whence he made journeys up the Columbia and Willamette Valleys and through eastern Washington and southern British Columbia. He spent some time, also, on the coast of California, below Monterey, but apparently never visited either the Sierra or the Cascades proper. His journal does not mention the capture of any marmots.[3] He might easily have secured the type specimen on his journey through eastern Washington, in which case it would be the form now known as *avara*, or he might have obtained it from Indians or travelers who had visited Mount Hood—a comparatively short distance from his headquarters—in which case it would be referable to the form which now bears the name *flaviventris*. In order to settle the question a specimen from Mount Hood and one from Okanogan, British Columbia, were submitted to Oldfield Thomas, who compared them with the type in the British Museum. He states as follows:

> The underside of forearms [in the type] are about as rufous and its rump as brown and finely speckled as the Oregon specimen, but it has got distinctly the broadly buffy mantle on the fore back so marked in the British Columbia specimen. The type is a good adult skin which has borne remaking very well. The skull, unfortunately, is not in existence.

The buffy mantle of which Mr. Thomas speaks is not a diagnostic character, since it appears in both the British Columbia and Cascade forms. The rufous color of the fore legs, however, is diagnostic, and, except for size and cranial characters, is the only sure distinguishing characteristic of the two forms. It seems clear, therefore, that the name *flaviventris* must be applied to the darker of the two forms found in Oregon and Washington, and I have therefore selected Mount Hood, Oreg., as the type locality. The series available from the Cascades is small and contains only one adult male skull—an old weathered specimen picked up on Mount Hood. Several adult females in the collection from Crater Lake and the Klamath Lake region, however, agree essentially with specimens from Fort Crook and the northern Sierra of California. South of Lake Tahoe *flaviventris* grades imperceptibly into the subspecies *sierrae*, occupying the southern end of the Sierra Nevada, in the Mount Whitney region. Intergradation with *avara* occurs in the region east of Klamath Lake and probably all along the east base of the Cascades.

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[1] Seven specimens from Crater Lake, Oreg., and northern parts of Sierra Nevada, Cal.

[2] Hooker, W. J. Companion to Botanical Mag., II, 1836, pp. 79–182.

[3] The statement [p. 92] that a curious species of *Arctomys* was secured and other references to "*Arctomys brachyurus*" [pp. 101–115] doubtless refer to species of either *Citellus* or *Aplodontia*.

Specimens examined.—Total number, 48, as follows:

California: Donner, 17; Emerald Bay, 1; Fort Crook, 3; Glen Alpine Springs, El Dorado County, 2;[1] Hope Valley, Alpine County, 2; Lassen Creek, Warner Mountains, 1; Mount Lassen, 2; Pine Creek, Lassen County, 1.

Nevada: Mount Siegel, Douglas County, 1;[2] Winters Mine, Douglas County, 1.[2]

Oregon: Crater Lake, 2; Fort Klamath, 3; Klamath Lake, 6; Linkville, 2; Mount Hood, 3; Summer Lake, 1.

MARMOTA FLAVIVENTRIS AVARA (BANGS).

PALLID YELLOW-BELLIED MARMOT.

(Pl. VII, fig. 3; Pl. XIII, fig. 3.)

Arctomys flaviventer avarus Bangs, Proc. New England Zool. Club, I, 1899, p. 68.
[*Marmota flaviventer*] *avarus* Trouessart, Cat. Mamm., Suppl., 1904, p. 344.

Type locality.—Okanogan, British Columbia.

Distribution.—Interior valleys and foothills of southern British Columbia and eastern Washington and Oregon.

Characters.—Similar to *flaviventris*, but smaller and colors paler, especially the underfur and fore legs; upperparts more extensively overlaid with buff.

Color.—General tone of upperparts chestnut-brown, heavily grizzled with buff; underfur at base deep mouse gray (varying to pale fuscous) succeeded by buffy white, the latter shading to light pinkish cinnamon on hinder back; long hairs blackish brown or clove brown subterminally, extensively tipped on fore back with warm buff and on hinder back with light buff; head and face blackish brown or dark chestnut-brown, with an indistinct narrow band of white or buff across face in front of eyes; sides of neck warm buff; fore legs and feet ochraceous-buff; hind legs, hind feet, and buttocks light ochraceous-buff, the feet varying to hazel; tail hazel, the hairs tipped with warm buff, their bases chestnut-brown; underparts ochraceous-buff or light ochraceous-buff, the bases of the hairs on belly chestnut-brown; sides of nose, lips, and chin white, bordered on throat with hazel.

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[1] Collection Mus. Vert. Zool., Univ. of California.

[2] Collection Field Mus. Nat. Hist.

Skull.—Similar to that of *flaviventris*, but decidedly smaller; nasals shorter, ending but little back of posterior border of premaxillae.

Measurements.—Adult male:[1] Total length, 495–660 (average 554); tail vertebrae, 149–178 (165); hind foot, 76–80 (78). *Skull:* Adult male:[2] Condylo-basal length, 85.7–86.5 (86.1); palatal length, 47.9–48.8 (48.3); postpalatal length, 34–34.8 (34.4); length of nasals, 36.6–37.6 (37.1); zygomatic breadth, 55.6–56.7 (56.1); breadth across mastoids, 39.1–42.2 (40.6); least interorbital breadth, 17.8–19.5 (18.6); breadth of rostrum, 19.4–20 (19.7); maxillary tooth row, 19–19.3. Adult female:[3] Condylo-basal length, 76.4–79.4 (77.9); palatal length, 42.6–44.6 (43.6); postpalatal length, 30.3–31 (30.7); length of nasals, 31.5–33.5 (32.8); zygomatic breadth, 52.4–52.7 (52.5); breadth across mastoids, 37.6–38.6 (38); least interorbital breadth, 17.1–18 (17.6); breadth of rostrum, 16.8–18.3 (17.3); maxillary tooth row, 17.8–19.1 (18.5).

Remarks.—This is a small, pale race of *flaviventris* living in the low foothills of eastern Oregon and Washington and southern British Columbia. It intergrades with *flaviventris* along the eastern base of the Cascades, in Oregon; with *nosophora* in northwestern Montana; and probably with *parvula* in northern Nevada. Specimens from Spokane Bridge, Wash., are a little darker than the typical form, and one from Elgin, Oreg., has a slightly larger skull. Specimens from Rockland, Wash., are intermediate between *avara* and *flaviventris*. Melanistic individuals are rare in this race; one from Pullman, Wash., has the fore back solid black, faintly grizzled with white, and the underfur pale gray; the hinder back is gray, the hairs being black subterminally and tipped with white; the belly and feet are black varied with buff; and the tail is black varied with tawny and white.

Specimens examined.—Total number, 53, as follows:

British Columbia: Ashcroft, 8; Cascade, 6;[4] Midway, 9;[4,5,6] Nicola Valley, 1;[6] Okanogan, 9; Penticton, 1;[4] Vernon, 1.

Oregon: Elgin, 2; Harney, 2; Guano Creek, Lake County, 1.

Washington: Cheney, 1; Diamond, 1; Douglas, 1; Pullman (14 miles southwest), 1; Rockland, 4; Spokane Bridge, 5.

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[1] Four specimens from Okanogan, British Columbia; and Douglas, Wash.

[2] Two specimens from Okanogan and Cascade, British Columbia.

[3] Four specimens from southern British Columbia.

[4] Collection Victoria Mem. Mus.

[5] Collection Field Mus. Nat. Hist.

[6] Collection Amer. Mus. Nat. Hist.

MARMOTA FLAVIVENTRIS SIERRAE SUBSP. NOV.

SOUTHERN SIERRA MARMOT.

(Pl. IV, fig. 4.)

Type from head of Kern River, Mount Whitney, Cal. (altitude, 9,300 feet). Adult ♀, No. $\frac{30834}{42859}$, U. S. Nat. Mus., Biological Survey collection. Collected Sept. 3, 1891, by Vernon Bailey; original number, 3242.

Distribution.—Higher parts of the southern Sierra Nevada from upper Kern River north to vicinity of Mono Lake.

Characters.—Similar to *flaviventris*, but colors redder and buffy mantle reduced or obsolete; skull smaller.

Color.—General tone of upperparts vinaceous-cinnamon to mikado brown, narrowly grizzled with white; underfur at base pale bister succeeded by pale pinkish buff, shading at tips into vinaceous-cinnamon and on hinder back to orange-cinnamon or mikado brown; long hairs chestnut-brown or blackish brown subterminally, tipped with white or buffy white; top of head and face dark cinnamon-drab to clove brown, with a rather large patch of white in front of eyes; sides of neck warm buff; fore legs and feet hazel varied with light ochraceous-buff; hind feet similar, or sometimes light buff, varied with brown; tail hazel, the bases of hairs light bister; underparts light ochraceous-buff, much mixed on sides and belly and bordered on throat with mikado brown.

Skull.—Similar to that of *flaviventris*, but decidedly smaller; very similar to that of *avara* but averaging slightly larger, and nasals longer.

Measurements.—Adult male topotype: Total length, 600; tail vertebrae, 200; hind foot, 83. Adult male:[1] 600; 165; 80. Adult female:[2] 555–645 (average 593); 167–186 (176); 75–80 (77). *Skull:* Adult male:[3] Condylo-basal length, 79.1–85.5 (average 84.7); palatal length, 44–50.5 (47.7); postpalatal length, 30.8–35 (33); length of nasals, 32.6–39 (36.3); zygomatic breadth, 52–58.3 (55.8); breadth across mastoids, 37.5–43.6 (40.8); least interorbital breadth, 17–20.3 (18.1); breadth of rostrum, 17–20 (18.6); maxillary tooth row, 20.2–20.7 (20.4). Adult female:[3] Condylo-basal length, 77.1–83.2 (80.1); palatal length, 43.2–47.2 (45.5); postpalatal length, 28.7–32.2 (30.5); length of nasals, 30.7–36.5 (34.2); zygomatic breadth, 51.4–55.4 (53.6); breadth across mastoids, 37–40 (38.4); least interorbital breadth, 15–18.7 (17.2); breadth of rostrum, 17.4–20.2 (18.4); maxillary tooth row, 19–20.2 (19.7).

Remarks.—By reason of the scarcity of specimens from the Cascades (the type region of *flaviventris*) it is impossible satisfactorily to characterize this southern race. The available specimens, however, show a decided reduction in size of skull southward, the small form apparently being confined to the high Sierra south of Mono Lake. Intergradation with *flaviventris* occurs in the region between Mono Lake and Lake Tahoe, and with *parvula* in the White Mountains, on the boundary between California and Nevada.

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[1] One specimen from East Fork Kaweah River, Cal.

[2] Five specimens from southern Sierra Nevada, Cal.

[3] Six specimens from southern Sierra Nevada, Cal.

Specimens examined.—Total number, 47, as follows:

California: Big Meadows, Tulare County, 3; Bishop Creek (altitude, 8,000 feet), 2; Cannell Meadows, Tulare County, 2;[1] Cottonwood Lakes, Inyo County, 3;[1] Independence Lake, 1;[1] Kaweah River (East Fork), 3; Lake Tenaya, 1; Menache Meadows (near Olancha Peak), 1; Mount Lyell, 1; Mount Whitney, 9; Mulkey Meadows (15 miles south of Mount Whitney), 1; Owens River (near Mammoth Pass), 1; Round Valley (12 miles south of Mount Whitney), 2; San Joaquin River (near head), 4; Siberian Outpost, Tulare County, 1;[1] Tuolumne Meadows, 10; Whitney Creek, Tulare County, 1;[1] Whitney Meadow, Tulare County, 1.[1]

MARMOTA FLAVIVENTRIS PARVULA Howell.

Nevada Marmot.

(Pl. VII, fig. 2; Pl. XIII, fig. 2.)

Marmota flaviventer parvula Howell, Proc. Biol. Soc. Washington, XXVII, 1914, p. 14.

Type locality.—Jefferson, Toquima Range, Nye County, Nev. (about 10 miles north of Belmont).

Distribution.—Toyabe and Toquima Ranges, Nev.; and White Mountains, Cal. (occurring from about 7,800 to 10,000 feet altitude); probably occupies also other desert ranges in central Nevada.

Characters.—Similar to *avara*, but smaller and colors darker; in color resembling *sierrae*, but upperparts less reddish and overlaid with a buffy mantle; skull smaller than that of *avara*, with narrower rostrum.

Color.—Underfur of upperparts slaty fuscous at base, succeeded by a broad area of cartridge buff on fore back and by light vinaceous-cinnamon on hinder back; long hairs dark brown subterminally, tipped on fore back with warm buff and on hinder back with white; top of head and face dark vandyke brown; a band of buff or buffy white across face in front of eyes; sides of nose and lips and a large patch on chin white varied with buff; sides of neck with a conspicuous patch of warm buff or cinnamon-buff; underparts ochraceous-tawny, shading to russet on abdomen and throat; fore legs tawny or russet, tipped with ochraceous-buff; fore and hind feet varying from light pinkish cinnamon to russet; tail above, dark chestnut-brown varied with tawny and grizzled with buff; beneath, blackish brown.

Skull.—Similar to that of *avara*, but decidedly smaller, with rostrum narrowed anteriorly.

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[1] Collection Mus. Vert. Zool., Univ. of California.

Measurements.—Adult female:[1] Total length, 470–500 (average, 480); tail vertebrae, 130–150 (141); hind foot, 70. *Skull:* Adult female:[2] Condylo-basal length, 71.3–73 (72.2); palatal length, 39.4–41 (40.2); postpalatal length, 27–28.6 (27.8); length of nasals, 29.4–30.5 (30); zygomatic breadth, 48.6–49 (48.8); breadth across mastoids, 34.2–34.3; least interorbital breadth, 15.5–15.6; breadth of rostrum, 17.2–17.4 (17.3); maxillary tooth row, 17.7–18.6 (18.2).

Remarks.—This is the smallest of the races of *flaviventris*. It most resembles typical *flaviventris* in color, but is even smaller than *avara*. Its small size was noted in the field by Vernon Bailey, who collected the type series. The range of the subspecies is not definitely known but probably extends at least to the Ruby Mountains where, on top of one of the peaks, Mr. Bailey found evidences of the presence of marmots.

A small series in badly worn pelage from White Mountains, Cal., is provisionally referred to this race, the specimens being intermediate in size between *parvula* and *sierrae*, and agreeing fairly well in color with the former, except for a stronger suffusion of red. One adult female skull agrees with skulls of *parvula* while a subadult male agrees equally well with comparable specimens of *sierrae*.

Two very young specimens from Mountain City, northeastern Nevada, are also provisionally referred to this race.

Specimens examined.—Total number, 16, as follows:

Nevada: Arc Dome, Toyabe Range, 6; Jefferson, Toquima Range, 1; Mountain City, 2.

California: White Mountains (altitude 9,300–10,000 feet), 7.

MARMOTA FLAVIVENTRIS ENGELHARDTI ALLEN.

ENGELHARDT MARMOT.

(Pl. VII, fig. 4; Pl. XIII, fig. 4.)

Marmota engelhardti Allen, Mus. Brooklyn Inst. Arts & Sci., Sci. Bul., I, 1905, p. 120.

Type locality.—Briggs [=Britt's] Meadow, Beaver Range, Utah (altitude 10,000 feet).

Distribution.—Beaver and Parawan Mountains, southern Utah; also Midvale, Idaho; exact limits of range unknown.

Characters.—Similar to *flaviventris* but smaller; underparts and hind feet darker (redder); buffy patches on sides of neck less extensive; larger than *parvula*, with darker feet and underfur; skull similar to that of *avara* but bullae larger.

Color.—General tone of upperparts vandyke brown, grizzled with buffy white; underfur fuscous at base succeeded by pinkish buff or pinksh cinnamon, the latter shading on sides to Rood's brown; long hairs blackish brown, tipped with light buff or buffy white; top of head and face blackish brown, with an irregular white patch in front of eyes; sides of head mixed brown and buffy white; sides of neck with a small area of ochraceous-buff; legs and feet hazel; tail above, dark clove brown, tipped with hazel; beneath, blackish brown; underparts hazel or ochraceous-tawny, the bases of hairs blackish brown; sides of nose, lips, and chin, white.

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[1] Three specimens from Toyabe and Toquima Ranges, Nev.

[2] Two specimens from same localities.

Skull.[1]—Similar to that of *avara* but audital bullae averaging larger and more inflated.

Measurements.—Adult female topotype: Total length, 525; tail vertebrae, 110;[2] hind foot, 75. Adult female from Parawan Mountains, Utah: 554; 154; 68. Immature female topotypes:[3] 485–535 (average 507); 139–163 (151); 71–77 (73). *Skull:* Adult female:[4] Condylobasal length, 76.8–80 (78.4); palatal length, 43.5–46.1 (44.8); postpalatal length, 29.5–30.7 (30.1); length of nasals, 31–34.6 (32.8); zygomatic breadth, 52.3–54 (53); breadth across mastoids, 36.5–37.7 (37.2); least interorbital breadth, 16.3–18 (17.1); breadth of rostrum, 17.8–18 (17.9); maxillary tooth row, 18.8–19 (18.9).

Remarks.—This race is an intermediate form connecting *flaviventris* and *nosophora*, darker beneath than the former but not so reddish as the latter and lacking also its buffy mantle. It is about the size of *avara* with a somewhat shorter tail, but much darker in color. A specimen from Parawan Mountains, Utah, is paler beneath than the type and topotypes, the underparts (except throat) and hind feet being ochraceous-buff varied with brownish. An immature specimen from Midvale, Idaho, provisionally referred to this form, agrees with it in color, except that the underfur on the shoulders is paler (light buff), and in skull characters so far as they can be determined.

Specimens examined.—Total number, 12, as follows:

Idaho: Midvale, 1.
Utah: Beaver Mountains, 6;[5] Parawan Mountains, 5.

MARMOTA FLAVIVENTRIS NOSOPHORA Howell.

Golden-Mantled Marmot.

(Pl. I; Pl. VIII, fig. 1; Pl. XIV, fig. 1.)

Marmota flaviventer nosophora Howell, Proc. Biol. Soc. Washington, XXVII, 1914, p. 15.

Type locality.—Willow Creek, 7 miles east of Corvallis, Mont. (altitude 4,000 feet).

Distribution.—Rocky Mountain region of Montana, Idaho, and Wyoming, from Flathead Lake, Mont., south to the Wasatch Mountains, Utah, and east to the Bighorn Mountains, Wyo.; altitudinal range from about 3,000 to 11,800 feet.

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[1] No adult males examined.
[2] Apparently abnormally short.
[3] Three specimens.
[4] Three specimens from Beaver and Parawan Ranges, Utah.
[5] Including type in collection Amer. Mus. Nat. Hist.

Characters.—About the size of *engelhardti*, but with longer tail; colors much more ochraceous above and redder below, the fore part of back overlaid with a mantle of golden buff. Compared with *dacota:* Slightly smaller, with upperparts less extensively reddish and more mixed with black, and underfur decidedly paler; skull averaging smaller, with relatively slenderer rostrum and much smaller palatal foramina.

Color.—Underfur of upperparts at base blackish brown on fore part of body, becoming fuscous on hinder parts, succeeded by a broad area of whitish buff (tilleul buff of Ridgway) shading (on hinder back) to pinkish cinnamon or pale russet; long hairs black subterminally, broadly tipped on fore part of back with warm- or ochraceous-buff and on hinder part with white or buffy white; top and sides of head blackish brown, with a conspicuous band of white or buffy white across face in front of eyes; sides of face mixed with cinnamon or white; sides of nose, lips, and chin white or buffy white; sides of neck with ochraceous-buff patches behind ears; fore legs kaiser brown; hind legs and rump warm buff; hind feet hazel to russet; tail chestnut-brown or blackish brown, varied with hazel or cinnamon-buff (fading to dull cinnamon or clay color); underparts hazel shaded with kaiser brown, becoming bright chestnut on throat and sometimes on belly. *Variation:* A dark, brownish color-phase occurring rarely, and seemingly most frequent at high altitudes, may be described as follows: General tone of upperparts dark brown grizzled with white; underfur at base mouse gray (shading on hinder back to fuscous) succeeded by buffy white (shading on hinder back to light pinkish cinnamon); long hairs blackish brown, tipped with white; top and sides of head blackish brown; underparts mixed blackish brown and pinkish buff in about equal proportions; throat shaded with russet; feet and tail blackish brown; legs brownish mixed with ochraceous-tawny. (Specimen from Lake Fork, Wind River Mountains, Wyo.; altitude 10,600 feet.)

Skull.—Females averaging larger than those of *engelhardti*, with broader rostrum and interorbital region and smaller bullae. Compared with *dacota:* Smaller, with narrower rostrum and interorbital region, and much smaller palatal foramina.

Measurements.—Adult male:[1] Total length, 590–600 (average 595); tail vertebrae 159–170 (165); hind foot, 78–79 (78.5). Old male from Pryor Mountains, Mont.: 670; 165; 96. Adult female:[2] 534–591 (565); 145–175 (165); 75–85 (78). *Skull:* Adult male:[3] Condylobasal length, 86.7–94.2 (90.6); palatal length, 47.7–53 (50.7); postpalatal length, 34.2–37.2 (36.2); length of nasals, 35.1–40.4 (37.8); zygomatic breadth, 55.7–63.7 (59); breadth across mastoids, 41.3–45

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[1] Two specimens from Bitterroot Valley, Mont.

[2] Seven specimens from Bitterroot Valley, Mont.

[3] Six specimens from Montana, Idaho, and Wyoming.

(43); least interorbital breadth, 17.8–22.2 (20.1); breadth of rostrum, 19–20.5 (19.8); maxillary tooth row, 19.3–20.8 (20). Adult female:[1] Condylo-basal length, 78.2–83.8 (80.4); palatal length, 44.1–47 (45.1); postpalatal length, 29.4–33.5 (31.2); length of nasals, 30.8–34.8 (32.4); zygomatic breadth, 53.2–54.5 (53.9); breadth across mastoids, 37.4–41.6 (39); least interorbital breadth, 18.5–19.7 (19.1); breadth of rostrum, 17–19.3 (18.3); maxillary tooth row, 19.7–20.5 (20.1).

Remarks.—This subspecies, one of the handsomest members of the *flaviventris* group, is abundant and generally distributed in the northern Rocky Mountain region of Montana, Idaho, and Wyoming. Closely related to *dacota* of the Black Hills, it probably intergrades with that race in central Wyoming. Specimens from the northern limit of its range (Horse Plains and Weeksville, Mont.) are considerably paler than the typical form, showing approach to *avara*. The southern limits of the range of *nosophora* are not known, only a few specimens having been seen from the Wasatch Mountains, and none from the Uinta Mountains, Utah. Intergradation with *engelhardti* probably occurs where their ranges meet.

A brown phase of this subspecies, having the tips of the hairs white instead of cinnamon-buff and the underparts mixed brown and buff instead of red, occurs in some localities with the normal phase. Several immature specimens, varying somewhat in color, have been examined from near timberline in the Wind River Mountains, Wyo. An adult female in very worn pelage from timberline in the Beartooth Mountains, Mont., is similar to those from the Wind River Mountains, but the brown of the upperparts is paler, evidently faded, and the underparts are mixed chestnut and black, shaded with tawny. Some specimens in this phase somewhat resemble externally the members of the *monax* group but the skulls are typical of *nosophora*.

This marmot serves as a host for the Rocky Mountain fever tick (*Dermacentor venustus*) and thus aids in the dissemination of the deadly spotted fever, particularly along the western side of the Bitterroot Valley, Mont., where the disease occurs in its most virulent form.

Specimens examined.—Total number, 62, as follows:

Idaho: Bear Lake (east side), 1; Bridge, 1; Conant Creek (upper Snake River), 1; Grace, 2; Henry Fork of Snake River, 1; Irwin (20 miles northwest), 1; Island Park, Snake River, 1; Moody Creek (upper Snake River), 1; Preuss Mountains, 1; Sawtooth National Forest, 2; Teton Basin, 1.

Montana: Bass Creek (in mountains northwest of Stevensville), 3; Beartooth Mountains, 3; Bozeman, 1; Como Lake, 1; Florence, 2; Horse Plains, 4; Jardine, 1; Pryor Mountains, 2; Ross Fork (15 miles above Darby), 2; Weeksville, 1; Willow Creek (in mountains east of Corvallis), 3.

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[1] Five specimens from Bitterroot Valley, Montana.

Utah: Blacksmith's Fork (near head), 1; Laketown, 1; Park City, Wasatch Mountains, 3.

Wyoming: Bighorn Mountains (Trapper's Creek), 6; Fremont Peak, 2; Jackson, 2; Kendall (12 miles north), 1; Lake Fork, Wind River Mountains, 3; Little Sandy Creek, 3; Lost Cabin (15 miles northwest), 1; Pahaska, 1; Salt River Mountains (10 miles southeast of Afton), 1; Sheridan, 1.

MARMOTA FLAVIVENTRIS DACOTA (MERRIAM).

BLACK HILLS MARMOT.

(Pl. IV, fig. 1; Pl. VIII, fig. 3; Pl. XIV, fig. 2.)

Arctomys flaviventer Grinnell, Ludlow's Black Hills of Dakota, 1875, p. 82. (Not of Audubon & Bachman).

Arctomys dacota Merriam, N. Am. Fauna No. 2, 1889, p. 8.

[*Marmota*] *dacota* Trouessart, Cat. Mamm., Suppl., 1904, p. 344.

Type locality.—Custer, S. Dak.

Distribution.—Black Hills, S. Dak., and Bear Lodge Mountains, Wyo., southwest to Bridger Pass, Wyo.

Characters.—Size large (equaling *flaviventris*); color similar to that of *nosophora* but underfur redder and less mixed with black; skull large, with broad rostrum and very large palatal foramina.

Color.—General tone of upperparts orange-cinnamon overlaid with warm buff; underfur at base fuscous or dark mouse gray, succeeded by pinkish cinnamon or vinaceous-cinnamon on fore back and by orange-cinnamon on hinder back, darkening to kaiser brown on sides (sometimes vinaceous-cinnamon to roots on fore back); long hairs on fore back bright cinnamon-buff at tips with an indistinct subterminal band of hazel or chestnut-brown; on hinder back chestnut-brown or blackish brown, tipped with white; buttocks warm buff; top of head and nose blackish brown with a band of yellowish white across face in front of eyes; sides of nose, lips, and chin, white or yellowish white; fore legs kaiser brown, feet russet; hind feet hazel; tail above, hazel mixed with chestnut-brown; beneath, blackish brown; underparts kaiser brown shaded with ochraceous-buff.

Skull.—Similar to that of *nosophora* but larger, with broad rostrum and broad palatal foramina.

Measurements.—Adult male:[1] Total length, 610–680 (average 643); tail vertebrae, 178–200 (185); hind foot, 81–92 (85). Adult female:[2] 525–627 (602); 130–188 (168); 79–84 (81). *Skull:* Adult male:[3] Condylo-basal length, 89.4–95.7 (92.5); palatal length, 50.8–52.2 (51.6); postpalatal length, 35–38.2 (36.6); length of nasals, 37.8–41.1 (39); zygomatic breadth, 59.5–61.4 (60.7); breadth across mastoids, 42.3–44.7 (43.3); least interorbital breadth, 21.8–23.2 (22.6); breadth of rostrum, 22–23.6 (23); maxillary tooth row, 21–21.7 (21.4). Adult female:[1] Condylo-basal length, 81.4–84.5 (83.1); palatal length, 45.4–47.7 (46.8); postpalatal length, 31.6–33 (32.4); length of nasals, 31.5–35.5 (33.9); zygomatic breadth, 54.2–56.7 (55.5); breadth across mastoids, 39.4–42.3 (40.5); least interorbital breadth, 19.6–22.5 (20.6); breadth of rostrum, 20–22.3 (20.9); maxillary tooth row, 20.1–20.5 (20.4).

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[1] Five specimens from Black Hills, S. Dak., and Bear Lodge Mountains, Wyo.

[2] Five specimens from Black Hills, S. Dak.

[3] Three specimens from Black Hills, S. Dak., and Bear Lodge Mountains, Wyo.

Remarks.—This form is the brightest of all the races of the species, the red and yellow shades being most pronounced and the blacks and browns reduced to a minimum. It is abundant in the Black Hills and apparently ranges through eastern Wyoming to Bridger Pass, intergrating with *luteola* in the Laramie Mountains.

Specimens examined.—Total number, 19, as follows:

South Dakota: "Black Hills," 1; Custer, 8; Savoy, 5; Tigerville (near Hill City), 1.

Wyoming: Bear Lodge Mountains, 1; Bridger Pass, 3.

MARMOTA FLAVIVENTRIS LUTEOLA Howell.

PARK MARMOT.

(Pl. VIII, fig. 2; Pl. XIV, fig. 3.)

Arctomys flaviventer Allen, Bul. Essex Inst., VI, 1874, p. 57. (Not of Audubon & Bachman.)

Marmota flaviventer Warren, Colorado Coll. Pub., Sci. Ser., XI, No. 46, 1906, p. 243. (Not of Audubon & Bachman.)

Marmota engelhardti Cary, N. Am. Fauna No. 33, 1911, p. 98. (Not of Allen.)

Marmota flaviventer luteola Howell, Proc. Biol. Soc. Washington, XXVII, 1914, p. 15.

Type locality.—Woods P. O., in Medicine Bow Mountains, Wyo. (altitude about 7,500 feet).

Distribution.—Mountains of northern Colorado and southeastern Wyoming, from Park County, Colo., (and probably Fremont County) north to the Laramie Mountains, Wyo.

Characters.—About the size of *dacota* and similar in color to it and *nosophora*, but underparts yellowish instead of deep red, and fore back overlaid with white instead of warm buff; skull similar to that of *nosophora*, but averaging narrower.

Color.—*Normal phase:* Underfur of upperparts dark mouse gray at base (shading on hinder back to deep dusky drab), succeeded on fore back by a broad area of warm buff and on hinder back by ochraceous-buff; long hairs blackish brown or dark chestnut-brown, tipped with light buff or buffy white; top of head and nose blackish brown, with a rather large patch of white or ochraceous-buff between eyes; sides of face mixed brown and buff; sides of nose, lips, and chin, white, yellowish white, or ochraceous-buff; sides of neck warm buff (the underfur ochraceous-buff); feet hazel or tawny; tail above, mixed hazel and chestnut-brown; beneath, blackish brown; underparts ochraceous-buff (bases of hairs brownish) varied with tawny along sides; rump and buttocks warm buff. *Dark phase* (specimen from Boulder County, Colo., altitude, 8,000 feet): Underfur cinnamon-buff becoming dark cinnamon on hinder back; entire body extensively mixed with dark chestnut-brown hairs, sparingly tipped on back with light buff; feet blackish brown shaded with tawny; light face-markings reduced.

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[1] Five specimens from Black Hills, S. Dak.

Skull.—Very similar to that of *nosophora*, but averaging relatively narrower, especially rostrum and interorbital region; bullae smaller.

Measurements.—Adult male:[1] Total length, 600–650 (average 623); tail vertebrae, 182–220 (200); hind foot, 86–90 (88). Adult female:[2] 552–618 (579); 137–192 (171); 78–85 (81). *Skull:* Adult male:[3] Condylo-basal length, 86–92.5 (88.3); palatal length, 48.4–51.1 (49.5); postpalatal length, 33.5–36.5 (35.2); length of nasals, 36–41 (38.4); zygomatic breadth, 55.7–60 (57.9); breadth across mastoids, 39–43.4 (41.5); least interorbital breadth, 17.3–21.8 (19.2); breadth of rostrum, 18.9–20.8 (19.6); maxillary tooth row, 19.9–21.4 (20.5). Adult female:[4] Condylo-basal length, 78.3–85 (81.4); palatal length, 43.7–47.6 (45.7); postpalatal length, 30–33.3 (31.5); length of nasals, 32.5–35 (33.7); zygomatic breadth, 51.7–54.9 (53.3); breadth across mastoids, 37.5–40.5 (38.6); least interorbital breadth, 16.4–17.8 (16.9); breadth of rostrum, 17.3–18.3 (17.8); maxillary tooth row, 19.3–21.4 (20.2).

Remarks.—In studying the marmots of this and related races in Colorado several puzzling problems have been encountered, the material at present available being insufficient satisfactorily to work out the characters and exact relationships of the forms. The specimens exhibit considerable individual variation, and, in addition to the dark phase already described, a light phase, characterized by less yellowish underparts and white tips to the hairs above, occurs in the same localities with the normal phase. Specimens in this light phase are known from Meeker, North Park, and Boulder County (altitude 10,300 feet). They rather closely resemble *engelhardti* externally, except that the underfur and feet are paler; the skulls, however, are typical of *luteola*.

The series from Laramie Mountains, Wyo., is intermediate between *luteola* and *dacota*, the pelage averaging redder and the skulls relatively shorter and broader than in typical *luteola*. Most of this series have large ochraceous-buff face markings. The series from Sulphur Springs, Colo., shows intergradation with *warreni*, the specimens being considerably redder than typical *luteola;* the skulls, however, are typical.

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[1] Three specimens from southern Wyoming and northern Colorado.

[2] Six specimens from northern Colorado.

[3] Four specimens from Laramie and Medicine Bow Mountains, Wyo., and Mount Lincoln, Colo.

[4] Five specimens from northern Colorado.

Specimens examined.—Total number, 42, as follows:

Colorado: Boulder County (altitude 8,000–11,000 feet), 4;[1] Coulter, 1; Elkhead Mountains, 1; Estes Park, 1; Lake John, 1;[2] Longs Peak, 1; Meeker, 2;[2] Middle Park, 1; Mount Lincoln, 6;[3] North Park, 1;[4] Pikes Peak, 1;[2] Sheephorn Pass, 4;[2] Steamboat Springs (18 miles below), 2;[2] Sulphur Springs, 5.[5]

Wyoming: Laramie Mountains, 7; Riverside, 2; Sherman, 1; Woods P. O., 1.

MARMOTA FLAVIVENTRIS WARRENI Howell.

Warren's Marmot.

(Pl. VI, fig. 4; Pl. XII, fig. 2).

Marmota flaviventer warreni Howell, Proc. Biol. Soc. Washington, XXVII, 1914, p. 16.

Type locality.—Crested Butte, Colo.

Distribution.—Western Colorado, from Garfield County south to Saguache County; exact limits of range unknown.

Characters.—Size large (equaling *dacota*); colors deep red with little buff; skull similar to that of *obscura,* larger than that of *dacota* or *luteola.*

Color.—General tone of upperparts hazel, the underfur at base between mouse gray and fuscous, succeeded by pinkish cinnamon or cinnamon; long hairs hazel subterminally, tipped with a small area of buffy white; top and sides of head dark chestnut or bay; sides of neck cinnamon-buff; underparts hazel, varied with ochraceous-tawny, becoming chestnut on lower abdomen and Sanford's brown on throat; lips soiled whitish, bordered with cream-buff or pinkish cinnamon; fore legs hazel, shading to auburn on feet; hind feet and toes hazel, varied with cinnamon; tail dark chestnut-brown at base, shading to hazel or tawny; under surface blackish chestnut-brown.

Skull.—(Known only from females): Larger than that of *dacota* with longer, slenderer rostrum and narrower palatal foramina; very similar to that of *obscura,* but averaging longer and relatively narrower.

Measurements.—Adult female (type): Total length, 565; tail vertebrae, 131; hind foot, 82. Skull:[6] Adult female: Condylo-basal length, 83.3–89.3 (average 85.9); palatal length, 47–49.3 (47.9); postpalatal length, 33.6–36.9 (35.5) length of nasals, 36.8–39.2 (38.1); zygomatic breadth, 57–59 (57.7); breadth across mastoids, 42.9–

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[1] Two in collection Field Mus. Nat. Hist.

[2] Collection E. R. Warren, Colorado Springs, Colo.

[3] Collection Mus. Comp. Zool.

[4] Collection Colo. Mus. Nat. Hist.

[5] Three in collection E. R. Warren; one in collection Amer. Mus. Nat. Hist.

[6] Three specimens from Crested Butte and Mud Springs, Colo.

44.7 (43.7); least interorbital breadth, 19–21.2 (20.2); breadth of rostrum, 18.7–20.3 (19.6); maxillary tooth row, 14.9–20.5 (17.4).

Remarks.—This form most nearly resembles *luteola* in color, but is much redder (less yellowish). Its skull also is much larger, agreeing rather with that of *obscura.* It is known from only a few specimens and its range has not been definitely determined. It probably will be found throughout west-central Colorado and adjacent parts of Utah. In both size and color it differs markedly from *engelhardti,* but additional material may show that the two forms intergrade. Intergradation with *luteola* is indicated by a series of specimens from Sulphur Springs (referred to *luteola*), and with *obscura* by a specimen from Florida, Colo. (referred to *obscura*).

Specimens examined.—Total number, 11, as follows:

Colorado: Crested Butte, 4;[1] Cochetopa Pass (9 miles south), 1; Mud Springs, Garfield County, 5;[2] Sapinero, 1.

MARMOTA FLAVIVENTRIS OBSCURA Howell.

Dusky Marmot.

(Pl. II, fig. 2; Pl. VIII, fig. 4; Pl. XIV, fig. 4.)

Marmota flaviventer obscura Howell, Proc. Biol. Soc. Washington, XXVII, 1914, p. 16.

Type locality.—Wheeler Peak, 5 miles south of Twining, N. Mex. (altitude, 11,300 feet).

Distribution.—Upper slopes of high peaks in northern New Mexico and southern Colorado, from Pecos Baldy, N. Mex., north to Sierra Blanca, vicinity of Fort Garland, and to San Juan Range near Osier, Colo. (formerly in the Manzano and Datil Mountains, N. Mex.); occurs in Hudsonian and upper Canadian Zones from about 9,600 feet altitude to the summits of the peaks (13,300–13,700 feet).

Characters.—Size large (exceeding *dacota* and equaling *flaviventris*); sexes about same size; tail long; colors dark brown mixed with white, with relatively little of the buff or tawny shades of other races; face usually without white markings; skull similar to those of *warreni* and *dacota.*

Color.—*Adults:* General tone of upperparts dark brown, grizzled with white, becoming cinnamon on hinder back in some individuals; underfur clove brown succeeded by pinkish buff, shading in some specimens to pinkish cinnamon on hinder back and rump; long hairs dark chestnut-brown, finely grizzled with white; head and face dark chestnut-brown or black, grizzled with white on sides of face, rarely with a whitish band across nose; sides of nose, lips, and chin, white or buffy white; feet dark chestnut-brown often extensively mixed with white or buffy hairs, or sometimes cinnamon-buff shaded with dark brown; tail chestnut-brown, shading to blackish brown beneath;

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[1] Three in collection E. R. Warren.

[2] Four in collection E. R. Warren; one in Amer. Mus. Nat. Hist.

underparts mixed dark chestnut-brown or blackish brown and pale buff (tilleul buff of Ridgway) in varying proportions, buff usually most pronounced in the median line; chin, and sometimes throat, shaded with tawny or bay. *Young* (Osier, Colo.): General tone above, clove brown (becoming slightly more tawny on hinder back) sparingly grizzled with white; underparts mixed blackish brown and light buff; tail snuff brown above, pale clove brown below; hind feet same color as under side of tail, overlaid with light buff.

Skull.—Similar to that of *dacota*, males about the same size or slightly smaller, females larger; nasals (in females) averaging longer; palatal foramina narrower; interpterygoid fossa broader; postorbital constriction narrow; similar to that of *warreni* but averaging shorter and relatively broader with slightly broader premaxillae.

Measurements.—Adult male:[1] Total length, 645–664 (average 655); tail vertebrae, 180–220 (204); hind foot, 90–92 (90.7). Adult female:[1] 630–670 (646); 180–220 (190); 88–90 (89.3). *Skull*: Adult male:[2] Condylo-basal length, 88.3–90.8 (89.5); palatal length, 49.4–52.7 (51); postpalatal length, 34–35.2 (34.6); length of nasals, 36.4–38.4 (37.4); zygomatic breadth, 60.2–60.4 (60.3); breadth across mastoids, 41.5–41.7 (41.6); least interorbital breadth, 21–21.1; breadth of rostrum, 21.9–23.3 (22.6); maxillary tooth row, 19–19.8 (19.4). Adult female:[3] Condylo-basal length, 84.5–89.5 (87.7); palatal length, 48.4–50.3 (49.3); postpalatal length, 31.9–35.7 (34.2); length of nasals, 35.4–39 (37.5); zygomatic breadth, 59.4–60.6 (59.8); breadth across mastoids, 41–43.8 (42.7); least interorbital breadth, 20.4–22.3 (21.1); breadth of rostrum, 22.3–22.4; maxillary tooth row, 20–21.

Remarks.—This is the darkest and one of the largest of the races of *flaviventris*. In its dark colors and the absence of light face markings it somewhat resembles the *monax* group. It is closely related to *warreni* and probably intergrades with it, but material from southern Colorado is too scanty to show clearly its relationships. A badly worn skin without skull from "Fort Massachusetts" [= mountains near] has been in the National Museum collection for many years, but not until 1903 and 1904, when Vernon Bailey collected a fine series of adults in the Pecos River and Taos Mountains, N. Mex., was it possible to determine the characters of the species.

In a series of 12 specimens from Osier, Colo., in the San Juan Range, about half of the individuals are considerably paler above than in the typical form, being uniformly pinkish cinnamon grizzled with white, without prominent brownish markings. A badly worn specimen from Florida, Colo., is decidedly redder above, particularly on the head and feet, indicating apparent intergradation with

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[1] Four specimens from New Mexico.

[2] Two specimens from Wheeler Peak, N. Mex.

[3] Three specimens from Wheeler Peak and Pecos Baldy, N. Mex.

warreni. Strangely, however, the skull of this specimen is not like that of either *warreni* or *obscura*, but agrees well with that of *luteola*.

Several lower jaws and fragments of crania, found in a cave on the Manzano Mountains by Archibald Rea, and broken pieces of a skull secured by Dr. Walter Hough from a cave on the Tularosa River near Old Fort Tularosa (south slope of the Datil Range) indicate the former occurrence of this species in those ranges. The jaws from the Manzano Mountains agree essentially with recent material, but the fragment from the Tularosa River is not specifically identifiable.

Of the habits of this marmot, Vernon Bailey in his field notes says:

> They live entirely in or among rocks and prefer open country, either in parks or above timber line. They often burrow under large bowlders in the parks and meadows, but more often live in fathomless piles of broken rock piled along the base of cliffs, or in seams and crevices of the cliffs themselves.

Specimens examined.—Total number, 24, as follows:

Colorado: Osier, San Juan Mountains (altitude, 9,625 feet), 12;[1] Florida, La Plata County (altitude, 7,200 feet), 1;[2] "Fort Massachusetts" [probably from Sierra Blanca Peak], 1.

New Mexico: Pecos Baldy, 2; Truchas Peak, 2; Wheeler Peak, 4; Aqua Fria Peak, 2.

Cranial Measurements of the Marmota flaviventris Group.

No.	Species and locality.	Sex.	Condylo-basal length.	Palatal length.	Postpalatal length.	Length of nasals.	Zygomatic breadth.	Breadth across mastoids.	Least inter-orbital breadth.	Breadth of rostrum.	Maxillary tooth row.	Remarks.
	Marmota flaviventris flaviventris.											
100532	Donner, Cal	♂	97.1	55	38.2	42.6	62.3	46.2	23	22.3	20.9	Adult.
4750	Fort Crook, Cal	♂	94	54	37.6	42.5	....	44.4	21.2	23	20	Do.
203080	Mount Hood, Oreg	[♂?]	92.5	52.3	....	....	....	41.1	22	23	19.5	Do.
80360	Crater Lake, Oreg	♀	87	48.7	33.7	37	58.4	40.7	19.2	19.6	20	Do.
191351	Donner, Cal	♀	86.2	48.7	34.5	37.2	....	40.4	17.3	19.4	21	Do.
[3] 11901	Glen Alpine Springs, Cal	♀	84.1	48.2	32.7	37	57.6	39.2	19	21.2	20.5	Do.
23951	Carson, Nev	♀	84.6	48.5	31.8	35.4	55.4	39.6	18.7	21.4	22.1	Do.
	Marmota flaviventris avara.											
99759	Okanogan, British Columbia	♂	85.7	47.9	34.8	37.6	56.7	42.2	19.5	20	19.3	Adult.
[4] 917	Cascade, British Columbia	♂	86.5	48.8	34	36.6	55.6	39.1	17.8	19.4	19	Do.
94343	Okanogan, British Columbia	♀	78	43.3	31	33.2	52.7	37.6	18	16.8	17.8	Do.
178842	.....do	♀	76.4	42.6	30.3	31.5	52.5	38.6	17.1	17.3	19.1	Do.
[4] 1107	Midway, British Columbia	♀	79.4	44.6	30.8	33.5	....	37.8	17.4	17	19	Do.
	Marmota flaviventris sierrae.											
[3] 15157	Cannell Meadows, Tulare County, Cal	[♂?]	85.5	47.8	34.3	36.6	57.3	40.7	18.5	20	20.2	Old.
[3] 15165	Whitney Creek, Tulare County, Cal	♂	90.2	50.5	35	37	58.3	43.6	20.3	20	20.5	Adult.
42641	Mount Whitney, Cal	♂	79.1	44	30.8	32.6	52	37.5	17	17.4	20.2	Subadult.
41198	.....do	♂	84.5	48	32.4	39	54.6	41.5	17.8	17	20.2	Do.
42859	.....do	♀	82.1	46.3	32.2	37.4	55.2	39.3	18.1	18.2	20	Adult.
[3] 15163	Whitney Meadow, Cal	♀	77.3	44.7	28.7	32	52.7	37	16.5	17.4	19	Old.
41950	Head San Joaquin River, Cal	♀	81	46	31	34.4	....	37.9	18.7	18.6	19.5	Do.

[1] Collection Colo. Mus. Nat. Hist.

[2] Collection Amer. Mus. Nat. Hist.

[3] Collection Mus. Vert. Zool., Univ. of California.

[4] Collection Victoria Mem. Mus.

Cranial measurements of the Marmota flaviventris group—Continued.

No.	Species and locality.	Sex.	Condylo-basal length.	Palatal length.	Postpalatal length.	Length of nasals.	Zygomatic breadth.	Breadth across mastoids.	Least inter-orbital breadth.	Breadth of rostrum.	Maxillary tooth row.	Remarks.
	Marmota flaviventris parvula.											
93689	Arc Dome, Toyabe Range, Nev..	♀	73	41	28.6	30.5	48.6	34.3	15.5	17.2	17.7	Adult.
93690	Jefferson, Toquima Range, Nev.	♀	71.3	39.4	27	29.4	49	34.2	15.6	17.4	18.6	Adult; type.
	Marmota flaviventris engelhardti.											
157828	Beaver Mountains, Utah........	[♀?]	80	46.1	30.7	34.6	54	37.5	17	17.8	19	Adult.
158978	.....do........................	♀	78.4	44.8	30.2	33	52.3	36.5	16.3	18	19	Do.
158500	Parawan Mountains, Utah.	♀	76.8	43.5	29.5	31	52.8	37.7	18	18	18.8	Do.
	Marmota flaviventris nosophora.											
168493	Ross Fork, Mont................	♂	86.7	47.7	34.2	35.1	55.7	41.3	17.8	19.5	20.1	Young adult.
156924	Sawtooth National Forest, Idaho	♂	90	50.3	35.5	38.5	59.5	43.1	19	19.6	19.5	Adult.
191363	Conant Creek, Idaho...........	♂	92.2	52.5	35.2	39.1	57.3	42	21	20.5	20.8	Young adult.
66709	Pryor Mountains, Mont.........	♂	94.2	53	37.2	40.4	63.7	45	22.2	20	20.4	Adult.
168473	Bitterroot Valley, Mont........	♀	83.8	46.2	33.5	34.8	54.5	41.6	19.5	19.3	20.2	Do.
168472	.....do........................	♀	78.2	42.5	31.8	30.8	54	37.6	19.2	18.7	20.3	Do.
168494	.....do........................	♀	79	45.5	30	32.8	53.2	40	19.7	17	19.8	Adult; type.
	Marmota flaviventris dacota.											
186474	Custer, S. Dak.................	♂	89.4	50.8	35	38	59.5	43	21.8	22	21.5	Subadult; type.
65920	Bear Lodge Mountains, Wyo....	♂	95.7	52.2	38.2	41.1	61.3	44.7	23.2	23.3	21.7	Adult.
25529	Bridger Pass, Wyo.............	♂	90.5	51	36.2	38.4	61.7	41.8	18.2	20.5	20.9	Do.
191365	Custer, S. Dak.................	♀	83.5	47.6	31.8	34.1	56.7	40.6	20.7	20	20.1	Do.
191366	.....do........................	♀	81.8	45.4	32.5	31.5	55.3	39.5	20	20.5	20.3	Do.
168884	Savoy, S. Dak..................	♀	84.5	47.7	33	35	55.7	40.7	19.6	20.4	20.5	Do.
	Marmota flaviventris luteola.											
186520	Medicine Bow Mountains, Wyo.	♂	87	48.4	33.5	36	55.7	40.6	17.3	19	21.4	Subadult type.
25523	Laramie Mountains, Wyo.......	♂	87.8	49.5	35.5	37.3	60	43.4	20.2	19.6	19.9	Adult.
[1] 175	Mount Lincoln, Colo...........	[♂?]	92.5	51.1	36.5	41	59.4	43	21.8	20.8	21	Old.
[2] 2279	Steamboat Springs, Colo.......	♀	85	47.6	33.3	34	54.9	40.5	17.4	17.7	21.4	Adult.
[2] 3098	Lake John, Colo................	♀	81.3	45.3	31.7	33	54	39	16.4	17.7	19.3	Do.
139082	Coulter, Colo..................	♀	78.3	43.7	30	34	52.3	38.5	16.5	17.3	19.5	Do.
	Marmota flaviventris warreni.											
202937	Crested Butte, Colo............	♀	89.3	49.3	36.1	39.2	59	44.7	21.2	20.3	16.7	Adult; type.
[2] 134	.....do........................	♀	83.3	47.4	36.9	36.8	57	42.9	19	19.9	14.9	Adult.
[2] 2512	Mud Springs, Colo.............	♀	85.1	47	33.6	38.2	57	43.4	20.3	18.7	20.5	Do.
	Marmota flaviventris obscura.											
135504	Wheeler Peak, N. Mex..........	♂	90.8	52.7	34	38.4	60.4	41.7	21	23.3	19	Adult.
133506	.....do........................	♂	88.3	49.4	35.2	36.4	60.2	41.5	21.1	21.9	19.8	Do.
128750	Pecos Baldy, N. Mex...........	♀	89.5	50.3	35	39	59.4	43.8	20.4	22.4	21	Do.
133505	Wheeler Peak, N. Mex..........	♀	84.5	48.4	31.9	35.4	59.4	41	20.5	22.3	20	Do.
133507	.....do........................	♀	88.1	49.3	35.7	38.2	60.6	43.3	22.3	22.3	20	Do.

[1] Collection Mus. Comp. Zool. [2] Collection E. R. Warren, Colorado Springs, Colo.

Marmota caligata Group.

The *caligata* group includes three species: *M. caligata*, *M. olympus*, and *M. vancouverensis*.

External characters.—Size large;[1] tail long (about 27 to 33 per cent of total length); ears relatively small (actually smaller than those of

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[1] Weight of 6 specimens as follows: 9 lbs. (2 ♀, *cascadensis*); 11 lbs. (♂, *cascadensis*); 11½ lbs. (♀, *olympus*); 15½ lbs. (♂, *oxytona*); 17 lbs. (old ♀, *cascadensis*).

M. monax); posterior pads on sole of hind foot subcircular and situated near edges of sole (see Pl. III, fig. 1); mammae:[1] P. $\frac{2}{2}$; A. $\frac{2}{2}$; I. $\frac{1}{1}=10$; colors mainly black and white, shaded with cinnamon-buff on hinder parts, or upperparts of solid colors—brownish drab, russet, or vandyke brown.

Cranial characters.—Skull with superior outline nearly straight (as in the other American groups); interorbital region and postorbital processes much as in the *flaviventris* group;[2] nasals narrowed posteriorly, usually about same width at posterior end as premaxillae or slightly narrower (wider in *olympus*); temporal ridges uniting in old age to form a pronounced sagittal crest; anterior portion of floor of basi-occipital nearly flat, bounded posteriorly by two low processes which unite at about middle of basi-occipital, continuing as a pronounced ridge to the foramen magnum; anterior portion often with two rather pronounced depressions on either side of the median ridge; palate beveled at posterior border (as in *flaviventris* group); interpterygoid fossa relatively narrow (compared with *monax*); palatal foramina variable in shape; molar teeth similar to those of *monax;* maxillary tooth rows divergent anteriorly; anterior face of incisors ivory yellow to orange-buff.

Geographic distribution.—From the Endicott Range, Alaska—the most northerly range in the Rocky Mountains—and the Alaska Peninsula south to the Olympic Mountains and Mount Rainier, Wash., and the Bitterroot and Salmon River Mountains in central Idaho; also on Vancouver Island. Confined entirely to mountain sides at and above timberline except in the north, where the animals live in open meadows and descend to tide water. (See fig. 3.)

Remarks.—The members of this group may readily be distinguished by their greater size and their peculiar coloration—either mixed black and white or solid brownish. All of the races of *Marmota caligata* are colored much alike, differing mainly in relative proportions of black and white and in skull characters. *M. olympus,* isolated on the Olympic Peninsula, has developed a brownish drab coloration with relatively little black or white, and *M. vancouverensis,* dwelling on Vancouver Island, has lost all of the black and white colors and attained a dark seal brown pelage.

MARMOTA CALIGATA (ESCHSCHOLTZ).

[Synonymy under subspecies.]

External characters.—(See under *Marmota caligata* group, excepting color.)

Cranial characters.—(See under *Marmota caligata* group.)

Color.—Fore part of back mixed black and white in varying proportions, sometimes with a buffy or brownish tinge; hinder back similar, but usually strongly suffused with cinnamon-buff or pinkish

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[1] As in *M. flaviventra.*

[2] Excepting *M. olympus,* which is relatively wider interorbitally.

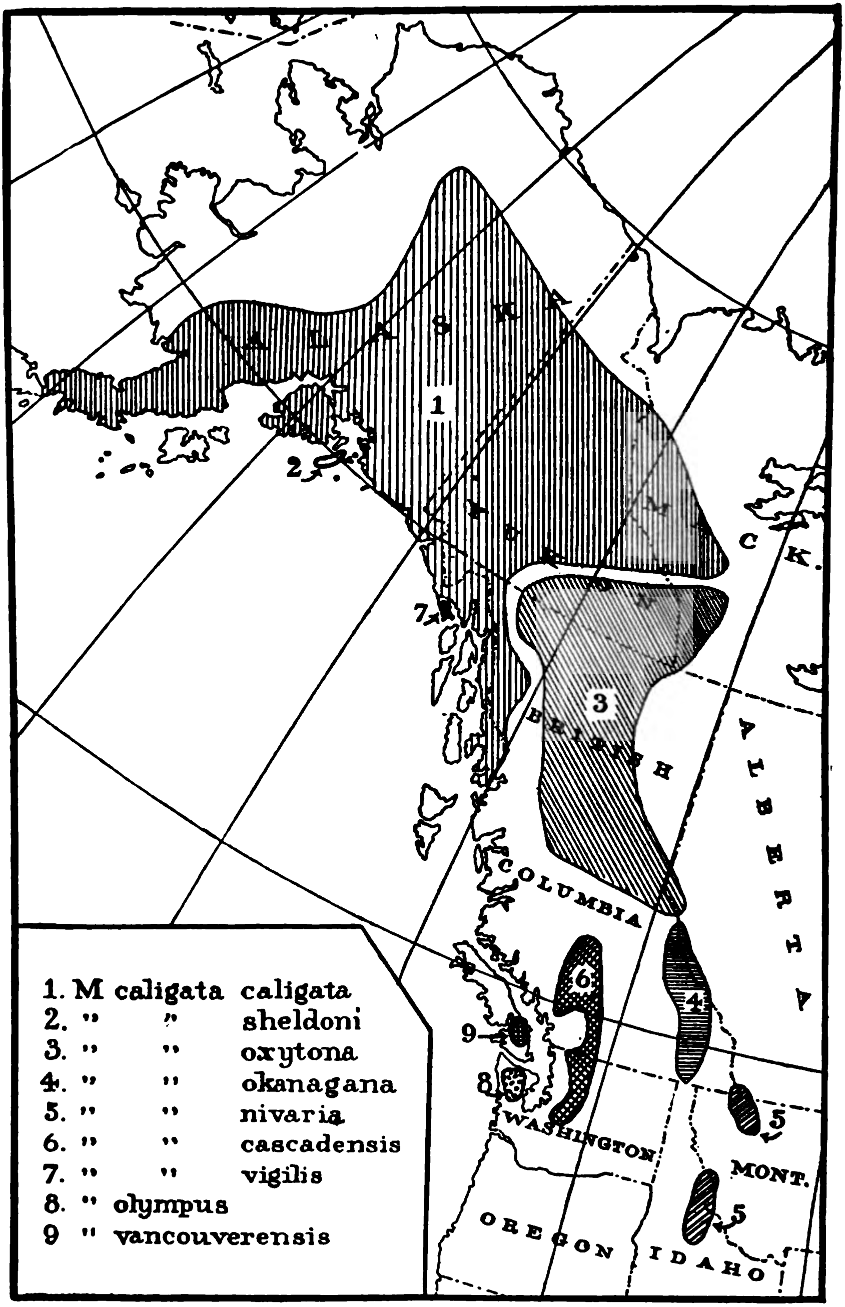

FIG. 3.—Distribution of the *Marmota caligata* group. Boundaries of ranges of subspecies are in many places theoretical.

cinnamon, sometimes tinged with hazel or vandyke brown; underfur dark hair-brown, bone brown, clove brown, bister, mouse gray, fuscous, or fuscous-black; sides of head and neck cinnamon, ochraceous-cinnamon, vandyke brown or blackish brown, more or less mixed with white or buffy white; borders of nose, lips, and chin soiled whitish; top of head and face black or blackish brown; face in front of and between eyes more or less extensively marked with white; legs usually same color as back; feet black or blackish brown, the front feet often with white markings, the hind feet mixed with cinnamon; tail above, cinnamon, pinkish cinnamon, cinnamon-buff, clay color, chestnut-brown, or bay, often mixed with hazel or vandyke brown; beneath, chestnut-brown, clove brown, blackish brown, or hessian brown, mixed with hazel, bay, or ochraceous-tawny; underparts white, grayish white, or clay color, varied with cinnamon, cinnamon-buff, or blackish brown.

Geographic distribution.—From the Endicott Range and the Alaska Peninsula, Alaska, south to Mount Rainier, Wash., and the Bitterroot and Salmon River Mountains, Idaho.

MARMOTA CALIGATA CALIGATA (ESCHSCHOLTZ).

NORTHERN HOARY MARMOT.

(Pl. IV, fig. 6; Pl. IX, fig. 4; Pl. XV, fig. 3.)

Arctomys pruinosa Richardson, Zool. Jour., III, 1828, p. 518. (Not of Gmelin.[1])
Arctomys caligata Eschscholtz, Zool. Atlas, Part II, 1829, p. 1, Plate VI.
Arctomys pruinosus Richardson, Fauna Boreali-Amer., I, 1829, p. 150; Baird, Mamm. N. Am., 1857, p. 345; Allen, Mon. N. Am. Rodentia, 1877, p. 924. (Not of Gmelin.)
Arctomys caligatus Tyrrell, Proc. Canadian Inst., 3rd Ser., VI, 1888, p. 88.
Marmotta caligata Allen, Bul. Amer. Mus. Nat. Hist., XIX, 1903, p. 539.
Marmota caligata MacFarlane, Proc. U. S. Nat. Mus., XXVIII, 1905, p. 751.

Type locality.—Bristol Bay, Alaska.

Distribution.—Alaska and Yukon, from the Portland Canal north on the coast to Bristol Bay, and in the interior to the Endicott Range and the mountains lying westward of Fort Good Hope, Mackenzie.

Characters.—Size medium (for the group); colors moderately white; skull relatively short and broad.

Color.—General tone of upperparts white, moderately tipped with black, becoming cinnamon-buff on hinder back and rump; underfur at base fuscous or dark mouse gray (shading on hinder back to bister), succeeded on fore back by a broad area of white which gradually shades to cinnamon-buff on hinder back (in some specimens underfur between shoulders white to roots); top of head and face black, with a white patch in front of eyes often covering the whole face; black of crown usually extending from ear back over shoulders in the form of two divergent (more or less indistinct) stripes; sides of face mixed brown and white (often nearly white); fore legs white or buffy white, hind legs pale cinnamon-buff; fore and hind feet black or blackish brown; tail above, cinnamon-buff, tipped with blackish brown or bay, the bases of the hairs extensively dark chestnut-brown (or sometimes natal brown); beneath, blackish brown or chestnut-brown, sometimes tinged with hazel or ochraceous-tawny; underparts soiled whitish, sometimes mixed with black or blackish brown.

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[1] *Arctomys pruinosa*, Gmelin, Syst. Nat., I, 1788, p. 144—based on the hoary marmot of Pennant. A careful comparison of Pennant's description with specimens of the several American species leads to the conclusion that this species is unidentifiable; the name *pruinosa* is therefore rejected.

Skull.—Relatively short and broad with short, broad rostrum; zygomata broadly expanded posteriorly; nasals long, extending beyond ends of premaxillae; postorbital constriction rather broad.

Measurements.—Adult male:[1] Total length, 710–715; tail vertebrae, 210–218; hind foot, 91–105. Adult female:[2] 675; 190; 95. *Skull:* Adult male:[3] Condylo-basal length, 96.5–100.6 (average 98.7); palatal length, 55.7–57.4 (56.4); postpalatal length, 36.5–38.2 (37.4); length of nasals, 38.4–42.3 (40.7); zygomatic breadth, 64.5–68 (66.3); breadth across mastoids, 44–46.2 (44.4); least interorbital breadth, 24.3–27.6 (25.8); breadth of rostrum, 23.7–26.1 (24.6); maxillary tooth row, 22–23.8 (22.6). Adult female:[4] Condylo-basal length, 92.8–96.4 (94.2); palatal length, 53–54.8 (53.8); postpalatal length, 35–38 (36.3); length of nasals, 38–39.7 (38.8); zygomatic breadth, 61.6–64.1 (62.7); breadth across mastoids, 40–43.3 (41.9); least interorbital breadth, 23–25 (23.9); breadth of rostrum, 22.1–24.5 (23.2); maxillary tooth row, 20.6–22.5 (21.7).

Remarks.—This race has an extensive distribution in Alaska and Yukon and shows little variation over its whole range. In the southern part it is confined to the region near the coast but in the north it occupies the interior mountain ranges as far east as the main Rocky Mountains in northwestern Mackenzie. In specimens from the Kenai Peninsula the nasals average somewhat shorter than in typical specimens, rarely extending back of the posterior ends of the premaxillae, but the skulls show no other differences. Specimens from the southern coast of Alaska as far south as the Portland Canal (with the exception of the *vigilis* series from Glacier Bay) are typical, but intergradation with *oxytona* occurs a short distance from the coast in northern British Columbia, the series from Cheonee Mountains being distinctly intermediate in character. The form occupying the northern Rockies in eastern Yukon and western

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[1] Two specimens from head of Coal Creek, Yukon.

[2] One specimen from same locality.

[3] Five specimens from Becharof Lake, Alaska.

[4] Seven specimens: 6 from Alaska Peninsula, 1 from Coal Creek, Yukon.

Mackenzie is provisionally referred to this race, no skulls from this entire region being available.

Specimens examined.—Total number, 102, as follows:

Alaska: Aleknagik Lake, 2; Becharof Lake, 12; Cape Elizabeth, 8; Charlie River (near head), 1; Chickamin River (Behm Canal), 2;[1] Cordova Bay, 3;[1] Disenchantment Bay, 1;[1] Fort Yukon, 1;[2] Hinchinbrook Island, 4; Juneau, 4; Kanatak, Portage Bay, 1; Kenai Mountains, 10;[1] Kenai Peninsula, 4; Mount McKinley, 1; Portage Bay, 5; Port Snettisham, 2;[1] Seldovia, 7;[3] Toklat River (near head), 1; Valdez Narrows, 1;[1] White Pass, 4; Yakutat Bay, 2; no specific locality, 2.

British Columbia: Bennett, 2; Cheonee Mountains, 15.[3]

Mackenzie: Fort Good Hope (mountains west of), 1.

Yukon: Coal Creek (head) 4; Kalzas Creek, Pelly River, 2.

MARMOTA CALIGATA VIGILIS HELLER.

GLACIER MARMOT.

Marmota vigilis Heller, Univ. of California Pub. Zool., V, 1909, p. 248.

Type locality.—West shore of Glacier Bay, Alaska.

Distribution.—Known only from type locality.

Characters.—Similar in size and skull characters to *caligata;* variable in color, but constantly darker than *caligata,* with a strong tendency to run to blacks and browns; top of head and hind feet always brown (except in purely melanistic individuals); underparts darker.

Color.—*Normal fresh pelage* (June 12): Upperparts soiled whitish with a buffy tinge; underfur clove brown at roots, sparingly mixed with dull brown or black; hinder back shading to cinnamon-buff, darkest on rump and hind legs, extensively tipped with blackish brown; underparts dull clay color mixed with grayish white; nose, top of head, and feet blackish brown; sides of face mixed cinnamon-buff and blackish brown; tail above, mixed clay color and chestnut-brown; beneath, blackish chestnut-brown shading to hessian brown in anal region. *Variation:* The above description is based on the lightest and apparently most normally colored individual in the series of topotypes. Between this phase and the pure black phase are found numerous intermediate specimens, some as white beneath as *caligata* and as dark above as *oxytona,* while others are solid blackish brown very similar to *M. vancouverensis,* but slightly blacker; the hind feet and usually the tail are blackish brown; fore feet black or very dark brown.

Skull.—Not appreciably different from that of *caligata.*

Measurements—Adult male:[4] Total length, 630–745 (average, 676); tail vertebrae, 197–210 (205); hind foot, 92–102 (97). Adult female:[5] 620–680 (652); 170–212 (191); 90–95 (92). *Skull:* Adult male:[5] Condylo-basal length, 97.2–98.4 (97.6); palatal length, 54.7–55.8 (55.3);

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[1] Collection Mus. Vert. Zool., Univ. of California.

[2] Collection Mus. Comp. Zool.

[3] Collection Amer. Mus. Nat. Hist.

[4] Five specimens from type locality.

[5] Three specimens from type locality.

postpalatal length, 36.7–38 (37.5); length of nasals, 38.9–41.5 (40.6); zygomatic breadth, 62–67.7 (64.8); breadth across mastoids, 43.2–44.6 (43.8); least interorbital breadth, 22.6–26 (24.3); breadth of rostrum, 21.1–23.5 (22.2); maxillary tooth row, 21.8–22.5 (22.2). Adult female:[1] Condylo-basal length, 93.7; palatal length, 51.6; postpalatal length, 37.7; length of nasals, 39.6; zygomatic breadth, 61.8; breadth across mastoids, 42.3; least interorbital breadth, 24.5; breadth of rostrum, 21.3; maxillary tooth row, 22.

Remarks.—This form is apparently an incipient species or race in which the characters have not as yet become fixed. It shows the same tendency to become brown that appears so strikingly in *M. vancouverensis*, and to a lesser degree in *M. olympus*. Its range is apparently limited to the region about Glacier Bay (since specimens from Yakutat Bay, White Pass, and Juneau are referable to *caligata*) but whether it is actually isolated is not known.

Specimens examined.—Ten, from type locality.[2]

MARMOTA CALIGATA SHELDONI Howell.

Montague Island Marmot.

Marmota caligata sheldoni Howell, Proc. Biol. Soc. Washington, XXVII, 1914, p. 18.

Type locality.—Montague Island, Alaska.

Distribution.—Known only from type locality.

Characters.—Similar to *caligata*, but size smaller and nasals shorter.

Color.—Upperparts mixed white and black, whitest on fore back, shading to cinnamon-buff on rump; underfur fuscous, shading on hinder back to natal brown; top of head black; a large white patch on face in front of eyes; sides of face mixed blackish brown and cinnamon; tail deep cinnamon-buff or ochraceous-buff, mixed with black, the bases of hairs chestnut-brown; underparts white, tinged with cinnamon.

Skull.—Similar to that of *caligata*, but decidedly smaller; nasals shorter and broader posteriorly, terminating usually about on a line with ends of premaxillae; premaxillae narrower.

Measurements.—Adult male topotype: Total length, 670; tail vertebrae, 185; hind foot, 94. Adult female topotype: 640; 180; 90. *Skull:* Adult male:[3] Condylo-basal length, 89.5–96.6 (average, 93.6); palatal length, 51.2–55.4 (53.3); postpalatal length, 34.3–37 (35.5); length of nasals, 35–39 (37.3); zygomatic breadth, 61.5–63.4 (62.4); breadth across mastoids, 41.3–42.4 (41.9); least interorbital breadth, 22.5–23.8 (23.3); breadth of rostrum, 20.5–21.8 (21.2); maxillary tooth row, 22.2–23.1 (22.5). Adult female:[1] Condylo-basal length, 88.7; palatal length, 50.2; postpalatal length, 34; length of nasals, 37; zygomatic breadth, 59.4; breadth across mastoids, 39.7; least interorbital breadth, 22.2; breadth of rostrum, 20.5; maxillary tooth row, 21.8.

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[1] One specimen from type locality.

[2] Seven in collection Mus. Vert. Zool., Univ. of California.

[3] Four specimens from type locality.

Remarks.—This race is a small form of *caligata*, confined to Montague Island, and differing from the typical race in size and skull characters. On Hinchinbrook Island, separated from Montague Island by only a narrow channel, the typical form is found.

Specimens examined.—Seven, from type locality.[1]

MARMOTA CALIGATA OXYTONA Hollister.

Robson Hoary Marmot.

(Pl. III, fig. 1; Pl. IV, fig. 3; Pl. IX, fig. 2; Pl. X, fig. 4.)

Marmota sibila Hollister, Smiths. Misc. Coll., Vol. 56, No. 35, 1912, p. 1. (Not *Arctomys sibila* Wolf.)

Marmota oxytona Hollister, Science, N. S., XXXIX, No. 998, Feb. 13, 1914, p. 251 (new name for *Marmota sibila* Hollister).

Type locality.—Head of Moose Pass branch of Smoky River, Alberta (altitude, 7,200 feet).

Distribution.—Interior of northern British Columbia, southwestern Mackenzie (?), and southern Yukon, from Teslin Lake and Liard River south to Barkerville, British Columbia, and the Mount Robson region, British Columbia and Alberta.

Characters.—Colors much blacker and tail darker than in *caligata;* skull larger and relatively narrower; males but little larger than females.

Color.—Upperparts as in *caligata*, but more extensively tipped with black, the underfur fuscous, shading to deep mouse gray or fuscous-black; hinder back dark cinnamon-buff, tinged with hazel and heavily mixed with black; top of head black with rather small white patches; cheeks ochraceous-cinnamon, varying to buffy white; tail above, dark cinnamon-buff mixed with bay, the bases of the hairs chestnut-brown or blackish brown; beneath, blackish brown, tinged with bay; underparts soiled whitish mixed with dull cinnamon, the bases of the hairs blackish brown.

Skull.—Much longer and relatively narrower than that of *caligata*, with long rostrum; zygomata less widely expanded posteriorly; zygomatic arch longer and distance from squamosal arm to tip of postorbital process greater; nasals terminating on a line with ends of premaxillae or slightly posterior; interpterygoid fossa relatively narrower.

Measurements.—Adult male:[2] Total length, 720–775 (average, 747); tail vertebrae, 210–235 (221); hind foot, 100–110 (105.6). Adult female:[3] 720–740 (730); 210; 95–105 (100). *Skull:* Adult male:[4]

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[1] Five in collection Mus. Vert. Zool., Univ. of California.

[2] Five specimens from British Columbia (Mount Robson to Thudade Lake).

[3] Two specimens from Sustut Mountains, British Columbia; and head of Smoky River, Alberta.

[4] Seven specimens from northern British Columbia.

Condylo-basal length, 101–107.4 (103.6); palatal length, 57–62.5 (58.9); postpalatal length, 38.3–41.7 (40.1); length of nasals, 41.5–45.3 (43.2); zygomatic breadth, 62.8–67.4 (65.8); breadth across mastoids, 44.2–48.3 (46.6); least interorbital breadth, 24–25.8 (25.3); breadth of rostrum, 22–24.8 (23.1); maxillary tooth row, 22–23.5 (22.8). Adult female:[1] Condylo-basal length, 101.8–104.6 (103.2); palatal length, 56.5–61.2 (58.9); postpalatal length, 36.4–41.1 (38.8); length of nasals, 41–43.6 (42.3); zygomatic breadth, 65.3–66.2 (65.8); breadth across mastoids, 45.9–47.3 (46.6); least interorbital breadth, 25.4–26.7 (26); breadth of rostrum, 23–23.3; maxillary tooth row, 22.7.

Remarks.—This is the darkest and one of the largest of the races of *caligata.* It intergrades with *caligata* in northern British Columbia and southern Yukon, and with *okanagana* in southern British Columbia, but the material at present available is not sufficient to show the exact limits of its range. Specimens from the Liard River (Fort Halkett and Fort Liard) are provisionally referred to this race, no skulls from this region being available and the skins being rather indeterminate in characters. Additional material from the northern Rockies may extend the known range of this form farther northward in the interior.

A series from near Teslin Lake, Yukon, is intermediate between *caligata* and *oxytona;* the skulls are smaller than those of typical *oxytona*, some of them even smaller than those of *caligata*, but relatively narrower. The nasals, though actually longer than in *caligata*, do not extend so far back of the ends of the premaxillae, in this character agreeing with *oxytona.*

Specimens examined.—Total number, 63, as follows:

Alberta: Smoky River (near Moose Pass), 2.

British Columbia: Babine (mountains near), 3; Barkerville, 5; Finlay River (mountains near head), 1; Fort Halkett, 1;[2] Klappan River (mountains near), 3; Laurier Pass, 1; Level Mountain, 1;[3] McConnell Creek (near Sustut Mountains), 1; Moose Pass, 2; Moose River (north fork), 2; Sheslay River, 2;[3] Stuart Lake, 2; Sustut Mountains, 4; Thudade Lake, 2.

Mackenzie: Fort Liard, 2.

Yukon: Teslin Lake (mountains near), 29.[4]

MARMOTA CALIGATA OKANAGANA (KING).

OKANAGAN HOARY MARMOT.

(Pl. X, fig. 3.)

Arctomys okanaganus[5] King, Narr. Journ. to Shores of Arctic Ocean, II, 1836, p. 236.

Arctomys pruinosus, Audubon and Bachman, Quad. N. Am., III, 1854, p. 17, Plate CIII. (Not of Gmelin.)

[*Marmota*] *okanagana* Howell, Proc. Biol. Soc. Washington, XXVII, 1914, p. 17 (type locality fixed).

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[1] Two specimens from head of Smoky River, Alberta.

[2] Collection Univ. of Michigan.

[3] Collection Amer. Mus. Nat. Hist.

[4] Collection Victoria Mem. Mus.; approaching *caligata.*

[5] "*Arctomys okanaganii*" on plate.

Type locality.—Gold Range, British Columbia.

Distribution.—Gold and Selkirk Ranges, British Columbia, and probably main range of the Rocky Mountains in Alberta from Banff to Henry House; exact limits unknown.

Characters.—Similar in color to *oxytona*, but averaging a little whiter; skull similar to that of *caligata*.

Color.—Upperparts much as in *oxytona*, but averaging whiter (some specimens almost as pale as *caligata*, but tail darker); underfur fuscous, shading to clove brown; fore back white, hinder back cinnamon-buff, more or less overlaid with black; sides of face cinnamon mixed with white; feet blackish brown, the hind feet grizzled with cinnamon; tail above, deep cinnamon (sometimes mixed with hazel) bordered with blackish brown, the bases of the hairs light chestnut-brown; beneath, blackish brown or dark chestnut-brown; underparts soiled whitish mixed with dull cinnamon.

Skull.—Similar to that of *caligata*, but averaging slightly larger, with narrower rostrum and postorbital constriction; nasals shorter, usually terminating little if any posterior to ends of premaxillae. Compared with *oxytona:* Decidedly shorter and relatively broader; braincase less elongated and distance from tip of postorbital process to squamosal arm of zygoma much less.

Measurements.—Adult male:[1] Total length, 670–754 (average, 694); tail vertebrae, 202–218 (212); hind foot, 91–106 (98). Adult female:[2] 659–735 (695); 202–224 (212); 93–103 (94). *Skull:* Adult male:[3] Condylo-basal length, 95–100 (97.7); palatal length, 53.4–57.4 (55.5); postpalatal length, 37–38.1 (37.8); length of nasals, 37–40.5 (38.9); zygomatic breadth, 64.8–67 (66.2); breadth across mastoids, 45.2–46 (45.6); least interorbital breadth, 24.9–27 (25.7); breadth of rostrum, 23–25.2 (24.2); maxillary tooth row, 21.9–22.7 (22.4). Adult female:[4] Condylo-basal length, 94.4–97.6 (96.4); palatal length, 53.5–55.3 (54.5); postpalatal length, 36–38.7 (37.3); length of nasals, 38–40.3 (39); zygomatic breadth, 62.2–66.3 (64.4); breadth across mastoids, 42.2–45.5 (43.7); least interorbital breadth, 21.9–24.9 (23.7); breadth of rostrum, 21–23.3 (21.9); maxillary tooth row, 21.4–22.4 (22).

Remarks.—This race apparently has a rather limited distribution, but its characters are well marked. It is not in any way intermediate between *oxytona* and *nivaria*, as might be expected from its geographic position, for, while it agrees with the former in color, its skull is much smaller than in either and more nearly resembles that of *caligata*. It is very much darker in color than *nivaria*, the differences being especially noticeable in the young.

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[1] Four specimens from Selkirk Range, British Columbia.
[2] Six specimens from same localities.
[3] Three specimens from Glacier and Nelson, British Columbia.
[4] Five specimens from same localities.

King, in naming the species in 1836, gave an excellent description and figure of the animal, based on two living individuals which had been brought from the Okanogan region to Norway House, Canada. These were later presented by King to the Zoological Gardens in London, where they were seen by Audubon, and after the death of the animals the skins served as the basis of the figure of the hoary marmot in his "Quadrupeds of North America." The type specimen, as I am informed by Oldfield Thomas, is still in the British Museum collection (No. 55.12.24.126) and agrees in every detail with the original description. The skull probably (not certainly) belonging to the skin is so diseased by menagerie life as to be of no use for comparison.

The original description is so complete and agrees so well with the form occurring in the Selkirks that I have no hesitation in fixing the type locality in the Gold Range—the first range to the eastward of Shuswap Lake—where it is likely the type was secured.[1]

Specimens examined.--Total number, 18, as follows:

Alberta: Henry House (mountains 15 miles south), 2.

British Columbia: Field, 2;[2] Glacier, 7; Spillimacheen River, 3;[3] Toad Mountain (6 miles south of Nelson), 4.

MARMOTA CALIGATA NIVARIA Howell.

Montana Hoary Marmot.

(Pl. X, fig. 2; Pl. XII, fig. 4.)

Marmota caligata nivaria Howell, Proc. Biol. Soc. Washington, XXVII, 1914, p. 17.

Type locality.—Mountains near Upper St. Marys Lake, Mont. (altitude, 6,100 feet).

Distribution.—Upper slopes (at and above timberline) of high mountains of northwestern Montana and of Bitterroot and Salmon River Mountains, Idaho (limits of range imperfectly known).

Characters.—Whitest member of the group, being very much whiter than either *okanagana* or *oxytona;* similar in size and skull characters to *oxytona.*

Color.—*Adults:* Fore part of back (to middle) snowy white, sparingly grizzled with black, the underfur dark hair-brown; hinder back pinkish cinnamon or cinnamon-buff mixed with black and white, the underfur bone brown; top of head black, much mixed with white and with a large white patch across face in front of eyes; sides of face brownish, mixed with white and cinnamon-buff; fore feet black with white patches; hind feet black, more or less mixed with cinnamon; underparts white, sparingly mixed on abdomen with cinnamon-buff; tail above, mixed pinkish cinnamon and chestnut-brown; beneath clove brown or blackish brown. *Young* (specimen from Elk Summit, Idaho): Nearly pure white above, shading to cinnamon-buff on hinder back; the underfur dark mouse gray; tail cinnamon-buff fringed at tip with blackish brown, the bases of hairs hair-brown; feet and top of head fuscous-black.

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[1] King defines the type region as follows: "In a small tract of country, on the borders of the Rocky Mountains, lying between the Columbia and Fraser Rivers, these animals are found in abundance, supplying with food and clothing the Okanagan Indians, whose territory is bounded to the north by the Seechwap Lake, and to the south by the Spokane River * * *." (King, R. Narr. Journ. to Shores of Arctic Ocean, II, 1836, p. 241.)

[2] Collection Victoria Mem. Mus.

[3] Collection Amer. Mus. Nat. Hist.

Skull.—(Known only from females.) Closely similar to that of *oxytona*, possibly averaging a little shorter; much larger and relatively narrower than that of *okanagana*, with broader rostrum.

Measurements.—Young adult male from type locality: Total length, 755; tail vertebrae, 250; hind foot, 110. Adult female:[1] 700–820 (average, 751); 200–245 (224); 95–113 (105). *Skull:* Adult female:[1] Condylo-basal length, 99.5–106.5 (102); palatal length, 58–61.4 (59.4); postpalatal length, 37.5–39.6 (38.2); length of nasals, 40.6–43.9 (42.2); zygomatic breadth, 64–66.6 (65.7); breadth across mastoids, 44.8–45.7 (45.5); least interorbital breadth, 23.3–27.2 (25.5); breadth of rostrum, 21.6–25 (23); maxillary tooth row, 22.2–24.4 (22.9).

Remarks.—This race widely differs in color from its nearest relatives, *okanagana* and *oxytona*, being even whiter than *caligata*. The characters are strikingly shown by young specimens which are almost pure white except on the hinder back and tail. Additional material is needed to determine the exact range of the form and the cranial characters of the males.

Specimens examined.—Total number, 14, as follows:

Idaho: Bitterroot Mountains (headwaters of Clearwater River), 3; Elk Summit, Salmon River Mountains, 2.

Montana: Upper St. Marys Lake (mountains near), 9.

MARMOTA CALIGATA CASCADENSIS HOWELL.

CASCADE HOARY MARMOT.

(Pl. X, fig. 1; Pl. XV, fig. 4.)

Marmota caligata cascadensis Howell, Proc. Biol. Soc. Washington, XXVII, 1914, p. 17.

Type locality.—Mount Rainier, Wash. (altitude, 6,000 feet).

Distribution.—Cascade Range (at and above timberline) from Mount Rainier, Wash., north to southern British Columbia.

Characters.—Size large (equaling *olympus* and *oxytona;* larger than *caligata*); color similar to that of *caligata*, but head and feet usually browner and underparts darker; skull similar to that of *oxytona* but relatively broader, much larger than that of either *caligata* or *okanagana*.

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[1] Four specimens from type locality.

Color.—Fore part of back white or creamy white, sparingly tipped with vandyke brown, the bases of the hairs with a broad area of the latter color; hinder back more extensively shaded with brown and sometimes tinged with cinnamon-buff; head and face vandyke brown or blackish brown, often with a white patch in front of eyes; sides of face and neck brownish, tinged with cinnamon or buffy white; feet blackish brown, often mixed with cinnamon; tail cinnamon-buff mixed with vandyke brown, becoming (in some specimens) dark chestnut-brown below; underparts mixed grayish white and blackish brown in varying proportions, faintly tinged with pale cinnamon-buff.

Skull.—Similar to that of *oxytona*, but relatively broader across zygomata and interorbital region; decidedly larger than that of its nearest neighbor, *okanagana*, with broader postorbital constriction; compared with *nivaria* it is shorter, with the zygomata more widely expanded and the premaxillae narrower.

Measurements.—Adult male:[1] Total length, 710–785 (average, 749); tail vertebrae, 205–252 (232); hind foot, 98–112 (102). Adult female:[2] 680–765 (714); 195–247 (219); 94–107 (99). *Skull:* Adult male:[3] Condylo-basal length, 106.2–107 (106.6); palatal length, 61.6–62.7 (62.2); postpalatal length, 39–40 (39.5); length of nasals, 42–44.5 (43.3); zygomatic breadth, 69.2–69.8 (69.5); breadth across mastoids, 48.5–49.2 (48.9); least interorbital breadth, 27.1–29 (28); breadth of rostrum, 24.5–24.7 (24.6); maxillary tooth row, 22.3–24.1 (23.2). Adult female:[4] Condylo-basal length, 95.4–102.5 (98.8); palatal length, 56.3–59 (57.7); postpalatal length, 34.6–39 (37.7); length of nasals, 37.8–44 (41.7); zygomatic breadth, 64.2–68.4 (65.8); breadth across mastoids, 44.9–49.4 (46.7); least interorbital breadth, 22.5–24.6 (23.8); breadth of rostrum, 19.3–22.7 (21.2); maxillary tooth row, 21–23.2 (22.1).

Remarks.—The Cascade hoary marmot differs from both *okanagana* and *oxytona* in whiter and browner (less black) coloration above; from *nivaria* in much more dusky colors, both above and below; and from *caligata* in much larger size and darker coloration. It is widely different from *olympus*, both in color and cranial characters. It is apparently isolated from all the other forms of the group, and no absolute intergrades have been examined, but the characters separating it from the forms of *caligata* are so slight that it seems best to regard it as a subspecies of the latter.

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[1] Four specimens from Mount Rainier and Cascade River, Wash.

[2] Six specimens from same localities.

[3] Two specimens from Cascade River, Wash., and Mount Baker Range, British Columbia.

[4] Seven specimens from Cascade Range, Wash., and Mount Baker Range, British Columbia.

Specimens examined.—Total number, 50, as follows:

British Columbia: Chilliwack (mountains near), 1;[1] Hope, 1;[2] Howe Sound (near head), 3;[1] Mount Baker Range (near United States boundary), 8;[3] Skagit River (mountains near head), 6; Spences Bridge, 1;[4] Tammi Hy Mountain, 2.[1]

Washington: Camp Chiloweyuck, 2; Cascade River (near head), 8; Easton (mountains near), 1; Mount Rainier, 7; "Northwest boundary survey" (probably Mount Baker Range), 10.

MARMOTA OLYMPUS (MERRIAM).

OLYMPIC MARMOT.

(Pl. II, fig. 1; Pl. IX, fig. 1; Pl. XV, fig. 1.)

Arctomys olympus Merriam, Proc. Acad. Nat. Sci., Philadelphia, 1898, p. 352.
[*Marmota*] *olympus* Trouessart, Cat. Mamm., Suppl., 1904, p. 344.

Type locality.—Head of Soleduck River, Olympic Mountains, Wash. (at timberline).

Distribution.—Upper slopes of the Olympic Mountains, Wash., above timberline (from about 4,000 feet altitude to near summits of peaks).

Characters.—Size large (about equaling *M. caligata cascadensis*); color in fresh pelage brownish drab mixed with white; feet brown; skull with broad rostrum and interorbital region.

Color.—*Fresh pelage:*[5] General tone brownish drab, more or less mixed with white hairs; underfur between hair-brown and benzo brown, becoming pale drab-gray at tips; long hairs glossy blackish brown mixed with more or less pure white ones; top and sides of head blackish brown, with a broad, white patch in front of eyes; sides of nose, lips, and chin white; legs brownish drab shading to blackish brown on the feet; tail clove brown, tipped with light pinkish cinnamon; underparts brownish drab mixed with white (or solid soiled whitish). *Worn summer pelage:* General tone of upperparts pinkish buff, varied with russet, the bases of hairs bister; feet chestnut-brown; tail above, pinkish buff or cinnamon-buff, mixed with snuff brown; beneath, snuff brown to chestnut-brown. *Young* (half-grown August specimens): General tone of upperparts grayish brown, becoming cinnamon on rump; underfur hair-brown at base, tipped on fore back with white, and on hinder back and rump with cinnamon or cinnamon-buff; top and sides of head and fore legs bister; feet dark clove brown; underparts light clove brown mixed with white or pale buff.

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[1] Collection Victoria Mem. Mus.

[2] Collection Mus. Comp. Zool.

[3] Including five in Mus. Comp. Zool.

[4] Collection Amer. Mus. Nat. Hist.

[5] No specimens in full winter pelage have been seen; description from August specimens just beginning to acquire the fall pelage.

Skull.—Similar to that of *cascadensis* but relatively narrower across zygomata and broader between orbits and across rostrum; postorbital constriction narrower; nasal branches of premaxillae narrower than nasals at posterior end.

Measurements.—Adult male:[1] Total length, 720–750 (average, 740); tail vertebrae, 210–237 (219); hind foot, 100–110 (106). Adult female:[2] 670–690 (680); 180–192 (186); 91–100 (95.5). *Skull:* Adult male:[3] Condylo-basal length, 105–109.8 (106.1); palatal length, 60–63 (61.1); postpalatal length, 39.6–42 (40.6); length of nasals, 40.6–46 (43.7); zygomatic breadth, 64.8–67.1 (65.6); breadth across mastoids, 46.2–47.3 (47); least interorbital breadth, 27.5–31.2 (29.8); breadth of rostrum, 24.5–27.7 (25.8); maxillary tooth row, 21.5–24.2 (23.1). Adult female:[4] Condylo-basal length, 99.5; palatal length, 58; postpalatal length, 37.5; length of nasals, 41.5; zygomatic breadth, 64.3; breadth across mastoids, 43.7; least interorbital breadth, 26.5; breadth of rostrum, 24.6; maxillary tooth row, 22.5.

Remarks.—The Olympic marmot is one of the largest members of the *caligata* group, about equaling in external measurements *cascadensis* and *oxytona*. Its skull averages about the size of that of *cascadensis*, but the largest male skull of *olympus* is longer than any other American marmot skull examined. In color the species is decidedly browner than any of the forms of *caligata*, though not nearly so brown as *vancouverensis*. The black colors of *caligata* have almost entirely disappeared, but some of the white hairs remain.

This species is confined to the high mountains of the Olympic Peninsula and is geographically isolated from its nearest relative, *cascadensis*.

Specimens examined.—Total number, 17, as follows:

Washington: Happy Lake, Olympic Mountains, 7;[5] Mount Ellinor, 3; Mount Steel, 4; Soleduck River (near head), Olympic Mountains, 3.

MARMOTA VANCOUVERENSIS Swarth.

Vancouver Island Marmot.

(Pl. IX, fig. 3; Pl. XV, fig. 2.)

Marmota vancouverensis Swarth, Univ. of California Pub. Zool., VII, 1911, p. 201; X, 1912, p. 89.

Type locality.—Mount Douglas, Vancouver Island, British Columbia (altitude, 4,200 feet).

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[1] Three specimens from Olympic Mountains, Wash.
[2] Two specimens from same locality.
[3] Five specimens from same locality.
[4] One specimen from same locality.
[5] Collection Field Mus. Nat. Hist.

Distribution.—Vancouver Island, British Columbia; apparently not generally distributed, and known at present only from "the mountains at the head of China Creek, some 20 miles south of Alberni, in the Golden Eagle Basin, and King Solomon Basin, and on the surrounding slopes and ridges." [1]

Characters.—Size of *M. caligata cascadensis;* color uniformly dark brown; skull relatively narrow with peculiarly shaped nasals.

Color.—Entire body, legs, and tail dark vandyke brown, the underfur being of the same color, the long hairs more blackish and glossy; sides of nose and chin soiled whitish; underparts sometimes irregularly blotched with white, and back rarely with a few scattering white hairs; feet glossy blackish brown. In worn pelage the upperparts and tail fade to sayal brown or clay color.

Skull.—Similar to that of *cascadensis,* but smaller and relatively narrower; zygomata less widely expanded; premaxillae relatively wider; nasals deeply emarginate posteriorly, the frontals projecting forward and forming a V-shaped notch between nasals; incisors white or yellowish white.

Measurements.—Adult male:[2] Total length, 660–710 (average, 684); tail vertebrae, 200–300 (222); hind foot, 90–102 (98.4). Adult female:[3] 680–720 (700); 210–240 (225); 100–105 (102.5). *Skull:* Adult male:[4] Condylo-basal length, 98–103.2 (99.9); palatal length, 57–59.5 (57.8); postpalatal length, 36.5–39.5 (37.8); length of nasals, 40–42.7 (41.4); zygomatic breadth, 64.2–65.5 (64.7); breadth across mastoids, 45.7–47 (46.1); least interorbital breadth, 23.2–24.4 (24); breadth of rostrum, 22–24 (22.9); maxillary tooth row, 23.6–24.7 (24.1). Adult female:[3] Condylo-basal length, 93.7–96.6 (95.2); palatal length, 54–54.3 (54.2); postpalatal length, 35.2–37.5 (36.3); length of nasals, 39–39.6 (39.3); zygomatic breadth, 61.6–62.6 (62.1); breadth across mastoids, 44; least interorbital breadth, 21.7–23 (22.3); breadth of rostrum, 21.5–21.6; maxillary tooth row, 23.1–23.7 (23.4).

Remarks.—This peculiar marmot, although clearly related to the mainland species (*caligata*) has, through isolation, developed striking characters, both external and cranial. The tendency of isolated coastal forms in this group to become brown (shown in a lesser degree by *M. caligata vigilis* and *M. olympus*) has reached the greatest extreme in this species, the black colors of the mainland forms being entirely lacking and the white reduced to scattering hairs.

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[1] Swarth, H. S. Loc. cit., X, 1912, p. 89.

[2] Five specimens from vicinity of type locality.

[3] Two specimens from vicinity of type locality.

[4] Four specimens from vicinity of type locality.

After a season's exploration of the southern part of Vancouver Island, Swarth came to the conclusion that the species is probably confined to a small area in the vicinity of Mount Douglas. He states:

> We found them in the mountains at the head of China Creek, some 20 miles south of Alberni, in the Golden Eagle Basin, and King Solomon Basin, and on the surrounding slopes and ridges. They were most abundant on Mount Douglas, the peak to the west of King Solomon's Basin. Wherever the ground was bare of timber, or but sparsely covered, as is the case over extensive areas at this point, the marmots had established themselves, burrowing under the rocks, and apparently never wandering very far from home. * * * Their extreme wariness is correlated with conspicuousness, for the dark brown pelage shows in marked contrast against either gray rocks or green grass. * * * They whistled but seldom, only one or two being heard during the three weeks we spent in their territory.[1]

None was found in apparently suitable situations on Mount Arrowsmith, and certain timber cruisers who had explored the wilder parts of the island stated that they had never seen a marmot.

Specimens examined.—Total number, 11,[2] as follows:[3]

British Columbia: Golden Eagle Basin, 1; King Solomon Basin, 3; Mount Douglas, 7.

Cranial Measurements of the Marmota caligata Group.

No.	Species and locality.	Sex.	Condylo-basal length.	Palatal length.	Postpalatal length.	Length of nasals.	Zygomatic breadth.	Breadth across mastoids.	Least interorbital breadth.	Breadth of rostrum.	Maxillary tooth row.	Remarks.
	Marmota caligata caligata.											
131440	Becharof Lake, Alaska	[♂?]	99	56.8	36.8	38.4	68	46.2	27.6	26.1	22	Adult.
131441	.....do	[♂?]	96.5	55.7	36.5	41.4	64.7	44	24.3	24	22.8	Do.
131442	.....do	[♂?]	100.6	57.4	38.2	42.3	67.8	44	25.8	24.1	23.8	Do.
98154	White Pass, Alaska	♂	100	57.7	37.8	43	65.2	44.2	23.4	23.6	23.4	Do.
131444	Becharof Lake, Alaska	[♀?]	92.8	53	35.8	38	63.4	43.2	24.3	22.9	21.9	Do.
128069	.....do	[♀?]	96.4	53.9	38	39.1	64.1	43	23.9	24.5	22.5	Do.
98153	White Pass, Alaska	♀	88.9	51	33.5	40.5	57.5	40	22.1	20	22	Do.
135161	Head of Coal Creek, Yukon	♀	94	53.9	36	38	62.3	43.3	24	22.1	21.7	Do.
	Marmota caligata vigilis.											
[4] 418	Glacier Bay, Alaska	♂	97.2	55.8	36.7	38.9	62	43.5	22.6	21.1	22.3	Do.
[4] 427	.....do	♂	97.3	54.7	37.8	41.4	64.8	43.2	24.2	22	21.8	Do.
97952	.....do	♂	98.4	55.5	38	41.5	67.7	44.6	26	23.5	22.5	Do.
97953	.....do	♀	93.7	51.6	37.7	39.6	61.8	42.3	24.5	21.3	22	Do.
	Marmota caligata sheldoni.											
137319	Montague Island, Alaska	♂	89.5	51.2	34.3	35	61.5	41.3	22.5	20.5	22.5	Do.
[4] 962	.....do	♂	96.6	55.4	36	39	63	42.3	23.5	21.6	23.1	Do.
[4] 961	.....do	[♂?]	96	54.5	37	38.8	63.4	42.4	23.8	21.8	22.4	Do.
[4] 969	.....do	[♂?]	92.3	52.2	34.8	36.4	61.5	41.5	23.2	21	22.2	Do.
[4] 960	.....do	♀	88.7	50.2	34	37	59.4	39.7	22.2	20.5	21.8	Do.

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[1] Swarth, H. S. Univ. of California Publ. Zool., X, 1912, pp. 89-90.

[2] All in collection Mus. Vert. Zool., Univ. of California.

[3] All about 20 miles south of Alberni, British Columbia, within a radius of 10 miles.

[4] Collection Mus. Vert. Zool., Univ. of California.

Cranial measurements of the Marmota caligata group—Continued.

No.	Species and locality.	Sex.	Condylo-basal length.	Palatal length.	Postpalatal length.	Length of nasals.	Zygomatic breadth.	Breadth across mastoids.	Least interorbital breadth.	Breadth of rostrum.	Maxillary tooth row.	Remarks.
	Marmota caligata oxytona.											
175565	Moose Forks, British Columbia..	♂	101	57	40	41.5	62.8	44.2	25	23	22	Adult.
202789	Sustut Mountains, Brit. Col.....	♂	102	58.6	39.5	42.7	66.8	46.5	25.8	22.2	23	Do.
202791	Lake Thudade, Brit. Col.........	♂	107.4	62.5	40.2	45.3	67.4	48.3	25.7	23.6	23.3	Do.
[1] 20766	Level Mountain, Brit. Col.......	♂	105	59	41	42.3	66.5	47	25.7	24.8	22	Do.
174503	Head of Smoky River, Alberta..	♀	101.8	56.5	41.1	43.6	65.3	45.9	25.4	23	22.7	Do.
174502	.....do.........................	♀	104.6	61.2	36.4	41	66.2	47.3	26.7	23.3	22.7	Do.
	Marmota caligata okanagana.											
67073	Glacier, British Columbia.......	♂	95	53.4	37	37	66.8	45.5	24.9	23	22.7	Do.
67076	.....do.........................	♂	100	57.4	37.3	40.5	67	46	27	25.2	22.5	Do.
66695	Nelson, British Columbia.......	♂	98.1	55.7	38.1	39.3	64.8	45.2	25.3	24.4	21.9	Do.
67072	Glacier, British Columbia.......	♀	96	54.4	37	40.3	64	43.7	23.5	21	22.1	Do.
67074	.....do.........................	♀	97.6	55.3	38.7	38.6	66.3	45.5	21.9	21.9	21.4	Do.
67075	.....do.........................	♀	94.4	53.3	36	38	65	42.9	24.6	23.3	22.3	Do.
	Marmota caligata nivaria.											
72222	St. Marys Lake, Mont...........	♀	106.5	61.4	39.6	41.2	66.6	45.7	27.2	25	22.8	Do.
72223	.....do.........................	♀	101	58	37.8	43.9	66.3	45.6	26.1	23.4	22.2	Do.
72225	.....do.........................	♀	101	59	37.8	43	65.8	44.8	25.4	21.6	24.4	Do.
72235	.....do.........................	♀	99.5	59	37.5	40.6	64	45.7	23.3	22	22.3	Do.
	Marmota caligata cascadensis.											
6871	Washington - British Columbia boundary.	♂	107	62.7	40	44.5	69.2	48.5	27.1	24.7	24.1	Do.
42793	Head of Cascade River, Wash...	♂	106.2	61.6	39	42	69.8	49.2	29	24.5	22.3	Do.
[2] 6840	Mount Baker Range, Brit. Col...	♀	101	59	37.7	43.2	65.6	47.6	23.3	21.8	21	Do.
42792	Head of Cascade River, Wash...	♀	102.5	58.7	39	44	68.4	49.4	23.1	22.7	23.2	Do.
90133	Mount Rainier, Wash............	♀	98.5	56.8	38	41.6	66.2	46.7	24.3	20.7	22.1	Do.
90134	.....do.........................	♀	95.4	56.3	38.4	43.9	66.7	47.8	22.5	21	22.3	Do.
	Marmota olympus.											
67611	Olympic Mountains, Wash......	♂	105	60.2	40.2	44	64.8	47.3	27.5	24.6	22.9	Do.
92768	.....do.........................	♂	105.3	61.8	39.6	43	65.1	47.3	31.2	26.3	21.5	Do.
[3] 6235	.....do.........................	♂	109.8	63	42	46	67.1	47.3	31.1	27.7	23.7	Do.
67612	.....do.........................	♀	99.5	58	37.5	41.5	64.3	43.7	26.5	24.6	22.5	Do.
	Marmota vancouverensis.											
[4] 12099	Vancouver Island, Brit. Col.....	♂	98	57	37	40.5	....	47	....	24	23.7	Do.
[4] 12092	.....do.........................	♂	98.2	57.2	36.5	40	64.2	45.7	23.2	22	24.3	Do.
[4] 12090	.....do.........................	♂	100.4	57.7	38.2	42.4	64.5	46	24.4	22.6	23.6	Do.
[4] 12091	.....do.........................	♂	103.2	59.5	39.5	42.7	65.5	45.8	24.3	23.2	24.7	Do.
[4] 12094	.....do.........................	♀	93.7	54	35.2	39	61.6	44	21.7	21.5	23.7	Do.
[4] 12100	.....do.........................	♀	96.6	54.3	37.5	39.6	62.6	44	23	21.6	23.1	Do.

---

[1] Collection Amer. Mus. Nat. Hist.
[2] Collection Mus. Comp. Zool.
[3] Collection Field Mus. Nat. Hist.
[4] Collection Mus. Vert. Zool., Univ. of California.

EXPLANATION OF PLATES.

PLATE II.

[Much reduced.]

FIG. 1. *Marmota olympus*, ♂ adult, Olympic Mountains, Wash., (altitude 5,000 feet), Aug. 28, 1897. (No. 92768, U. S. Nat. Mus., Biological Survey collection.)

2. *Marmota flaviventris obscura*, ♂ adult, Wheeler Peak, N. Mex. (altitude 12,400 feet), July 27, 1904. (No. 133506, U. S. Nat. Mus., Biological Survey collection.)

PLATE III.

[Natural size.]

FIG. 1. *Marmota caligata oxytona*. Klappan Mountain, British Columbia. (No. 170-683, U. S. Nat. Mus., Biological Survey collection.)

2. *Marmota flaviventris flaviventris*. Summer Lake, Oreg. (No. 89311, U. S. Nat. Mus., Biological Survey collection.)

3. *Marmota monax preblorum*. Woburn, Mass. (No. 78358, U. S. Nat. Mus., Biological Survey collection.)

PLATE IV.

[Three-fourths natural size.]

FIG. 1. *Marmota flaviventris dacota*, ♂ adult, Bridger Pass, Wyo. (No. 25529, U. S. Nat. Mus., Biological Survey collection.)

2. *Marmota monax monax*, ♂ adult, Peaks of Otter, Va. (No. 143962, U. S. Nat. Mus.)

3. *Marmota caligata oxytona*, ♂ adult, Lake Thudade, British Columbia. (No. 202791, U. S. Nat. Mus., Biological Survey collection.)

4. *Marmota flaviventris sierrae*, ♀ adult, head of San Joaquin River, Cal. (No. 41950, U. S. Nat. Mus., Biological Survey collection.)

5. *Marmota monax rufescens*, ♂ adult, Lake George, N. Y. (No. 67695, U. S. Nat. Mus., Biological Survey collection.)

6. *Marmota caligata caligata*, [♂ ?] adult, Becharof Lake, Alaska. (No. 131437, U. S. Nat. Mus., Biological Survey collection.)

PLATE V.

[Three-fourths natural size.]

FIG. 1. *Marmota monax monax*, ♂ adult, Peaks of Otter, Va. (No. 143962, U. S. Nat. Mus.)

2. *Marmota monax rufescens*, ♂ adult (type), Elk River, Minn. (No. 186521, U. S. Nat Mus., Merriam collection.)

3. *Marmota monax preblorum*, ♂ adult, Wilmington, Mass. (No. 78355, U. S. Nat. Mus., Biological Survey collection.)

4. *Marmota monax ignava*, ♂ adult, L'Anse au Loup, Labrador. (No. 8871, Mus. Comp. Zool.)

Plate VI.

[Three-fourths natural size.]

Fig. 1. ***Marmota monax canadensis***, ♂ adult, Murray Bay, Quebec. (No. 7603, Field Mus. Nat. Hist.)

2. ***Marmota monax petrensis***, ♂ adult (type), Revelstoke, British Columbia. (No. 203532, U. S. Nat. Mus., Biological Survey collection.)

3. ***Marmota monax ochracea***, [♂ ?] subadult, Babine Mountains, British Columbia. (No. 202785, U. S. Nat. Mus., Biological Survey collection.)

4. ***Marmota flaviventris warreni***, ♀ adult (type), Crested Butte, Colo. (No. 202937, U. S. Nat. Mus., Biological Survey collection.)

Plate VII.

[Three-fourths natural size.]

Fig. 1. ***Marmota flaviventris flaviventris***, ♂ adult, Donner, Cal. (No. 100532, U. S. Nat. Mus., Biological Survey collection.)

2. ***Marmota flaviventris parvula***, ♀ adult (type), Jefferson, Nev. (No. 93690, U. S. Nat. Mus., Biological Survey collection.)

3. ***Marmota flaviventris avara***, ♂ adult, Okanogan, British Columbia. (No. 99750, U. S. Nat. Mus., Biological Survey collection.)

4. ***Marmota flaviventris engelhardti***, ♀ adult, Beaver Mountains, Utah. (No. 158978, U. S. Nat. Mus., Biological Survey collection).

Plate VIII.

[Three-fourths natural size.]

Fig. 1. ***Marmota flaviventris nosophora***, ♂ adult, Sawtooth National Forest, Idaho. (No. 156924, U. S. Nat. Mus., Biological Survey collection.)

2. ***Marmota flaviventris luteola***, [♂ ?] adult, Mount Lincoln, Colo. (No. 175, Mus. Comp. Zool.)

3. ***Marmota flaviventris dacota***, ♂ adult, Bear Lodge Mountains, Wyo. (No. 65920, U. S. Nat. Mus., Biological Survey collection.)

4. ***Marmota flaviventris obscura***, ♂ adult, Wheeler Peak, N. Mex. (No. 135504, U. S. Nat. Mus., Biological Survey collection.)

PLATE IX.

[Three-fourths natural size.]

Fig. 1. ***Marmota olympus***, ♂ adult, Olympic Mountains, Wash. (No. 6325, Field Mus. Nat. Hist.)

2. ***Marmota caligata oxytona***, ♂ adult, Lake Thudade, British Columbia. (No. 202791, U. S. Nat. Mus., Biological Survey collection.)

3. ***Marmota vancouverensis***, ♂ adult, Vancouver Island, British Columbia. (No. 12091, Mus. Vert. Zool., Univ. of California.)

4. ***Marmota caligata caligata***, [♂ ?] adult, near Portage Bay, Alaska. (No. 131440, U. S. Nat. Mus., Biological Survey collection.)

PLATE X.

[Three-fourths natural size.]

Fig. 1. *Marmota caligata cascadensis*, ♂ adult, head of Cascade River, Wash. (No. 42793, U. S. Nat. Mus., Biological Survey collection.)

2. *Marmota caligata nivaria*, ♀ adult, St. Marys Lake, Mont. (No. 72222, U. S. Nat. Mus., Biological Survey collection.)

3. *Marmota caligata okanagana*, ♂ adult, Glacier, British Columbia. (No. 67073, U. S. Nat. Mus., Biological Survey collection.)

4. *Marmota caligata oxytona*, ♀ adult (type), Head of Smoky River, Alberta. No. 174503,U. S. Nat. Mus.)

PLATE XI.

[Three-fourths natural size.]

Fig. 1. *Marmota monax monax*, ♂ adult, Peaks of Otter, Va. (No. 143962, U. S. Nat. Mus.)

2. *Marmota monax rufescens*, ♂ adult (type), Elk River, Minn. (No. 186521, U. S. Nat. Mus., Merriam collection.)

3. *Marmota monax preblorum*, ♂ adult, Wilmington, Mass. (No. 78355, U. S. Nat. Mus., Biological Survey collection.)

4. *Marmota monax canadensis*, ♂ adult, Murray Bay, Quebec. (No. 7603, Field Mus. Nat. Hist.)

PLATE XII.

[Three-fourths natural size.]

Fig. 1. *Marmota monax ignava*, ♂ adult, L'Anse au Loup, Labrador. (No. 8871, Mus. Comp. Zool.)

2. *Marmota flaviventris warreni*, ♀ adult (type), Crested Butte, Colo. (No. 202937, U. S. Nat. Mus., Biological Survey collection.)

3. *Marmota monax ochracea*, [♂ ?] subadult, Babine Mountains, British Columbia. (No. 202785, U. S. Nat. Mus., Biological Survey collection.)

4. *Marmota caligata nivaria*, ♀ adult, St. Marys Lake, Mont. (No. 72222, U. S. Nat. Mus., Biological Survey collection.)

PLATE XIII.

[Three-fourths natural size.]

Fig. 1. *Marmota flaviventris flaviventris*, ♂ adult, Donner, Cal. (No. 100532, U. S. Nat. Mus., Biological Survey collection.)

2. *Marmota flaviventris parvula*, ♀ adult (type), Jefferson, Nev. (No. 93690, U. S. Nat. Mus., Biological Survey collection.)

3. *Marmota flaviventris avara*, ♂ adult, Okanogan, British Columbia. (No. 99759, U. S. Nat. Mus., Biological Survey collection.)

4. *Marmota flaviventris engelhardti*, ♀ adult, Beaver Mountains, Utah. (No. 158978. U. S. Nat. Mus., Biological Survey collection.)

PLATE XIV.

[Three-fourths natural size.]

Fig. 1. *Marmota flaviventris nosophora*, ♂ adult, Sawtooth National Forest, Idaho. (No. 156924, U. S. Nat. Mus., Biological Survey collection.)

2. *Marmota flaviventris dacota*, ♂ adult, Bear Lodge Mountains, Wyo. (No. 65920, U. S. Nat. Mus., Biological Survey collection.)

3. *Marmota flaviventris luteola*, [♂ ?] adult, Mount Lincoln, Colo. (No. 175, Mus. Comp. Zool.)

4. *Marmota flaviventris obscura*, ♂ adult, Wheeler Peak, N.Mex. (No. 135504, U. S. Nat. Mus., Biological Survey collection.)

PLATE XV.

[Three-fourths natural size.]

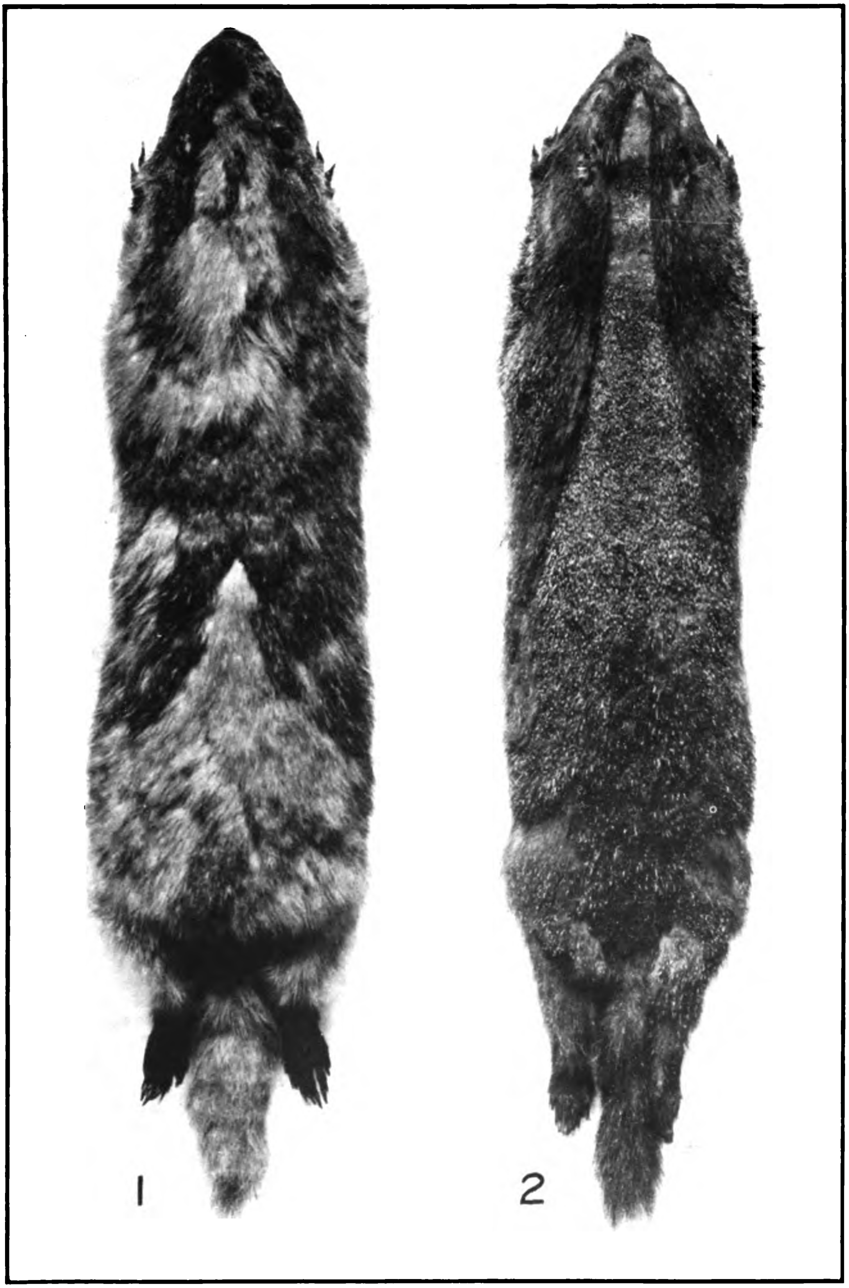
Fig. 1. *Marmota olympus*, ♂ adult, Olympic Mountains, Wash. (No. 6325, Field Mus. Nat. Hist.)

2. *Marmota vancouverensis*, ♂ adult, Vancouver Island, British Columbia. (No. 12091, Mus. Vert. Zool., Univ. of California.)

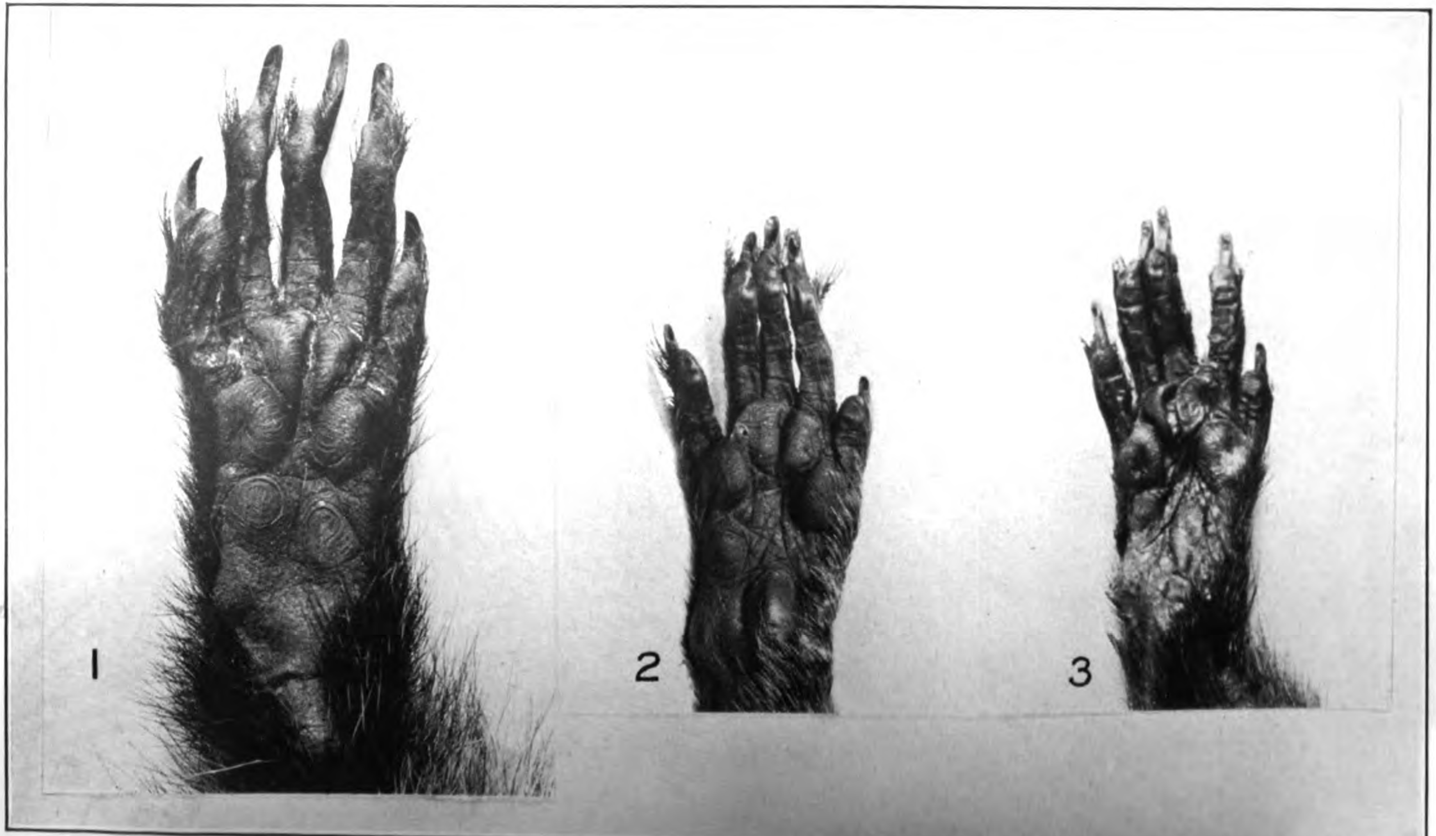
3. *Marmota caligata caligata*, [♂ ?] adult, near Portage Bay, Alaska. (No. 131440; U. S. Nat. Mus., Biological Survey collection.)

4. *Marmota caligata cascadensis*, ♂ adult, head of Cascade River, Wash. (No. 42793, U. S. Nat. Mus., Biological Survey collection.)

PLATE II.

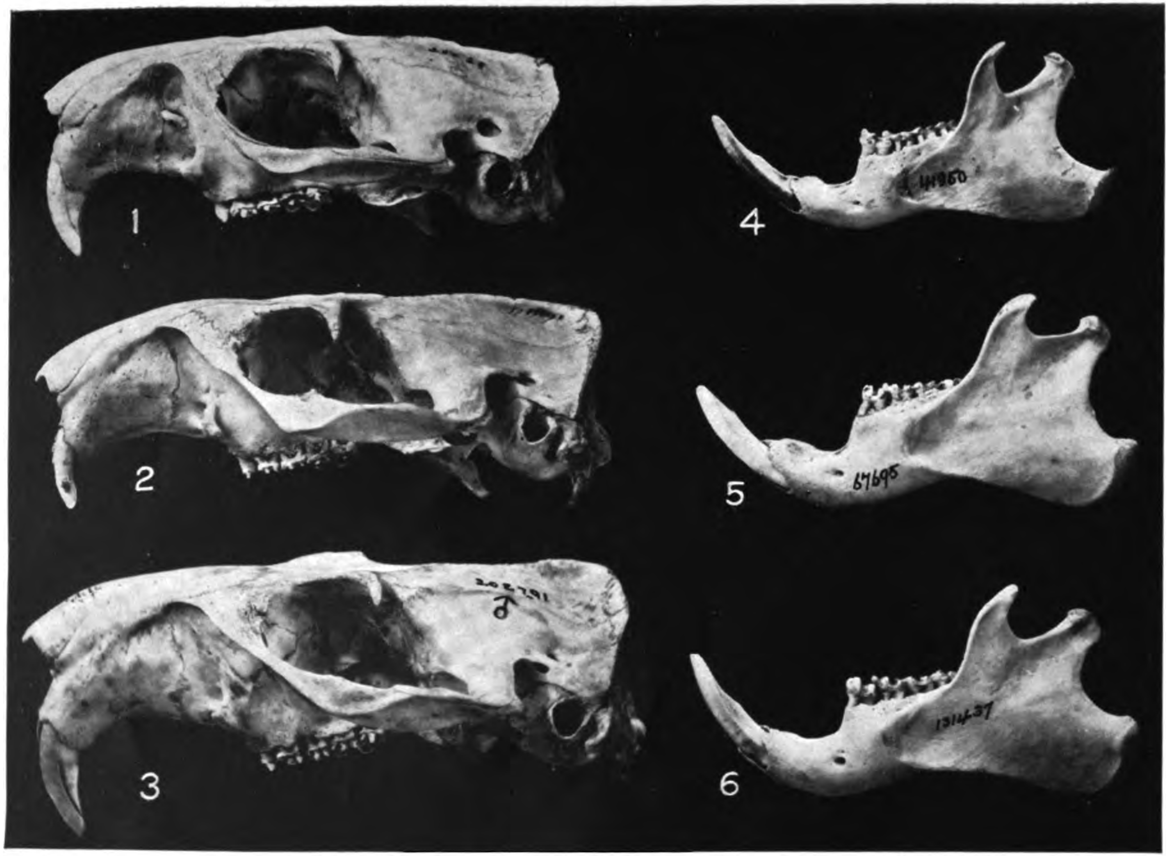


SKINS OF (1) MARMOTA OLYMPUS AND (2) M. FLAVIVENTRIS OBSCURA, SHOWING MOLT.



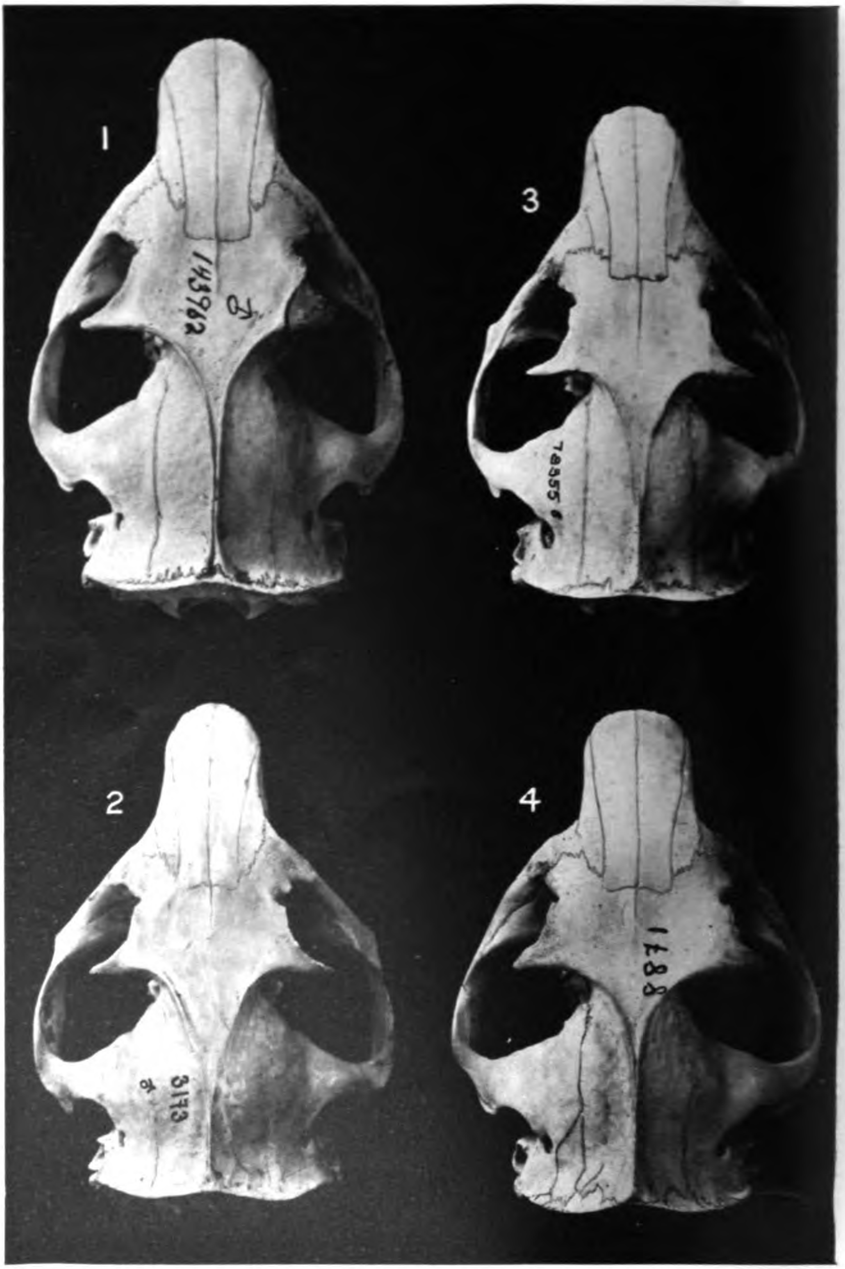
HIND FEET OF AMERICAN MARMOTS, SHOWING SOLE PADS.

1. Marmota caligata oxytona. 2. Marmota flaviventris flaviventris. 3. Marmota monax preblorum.



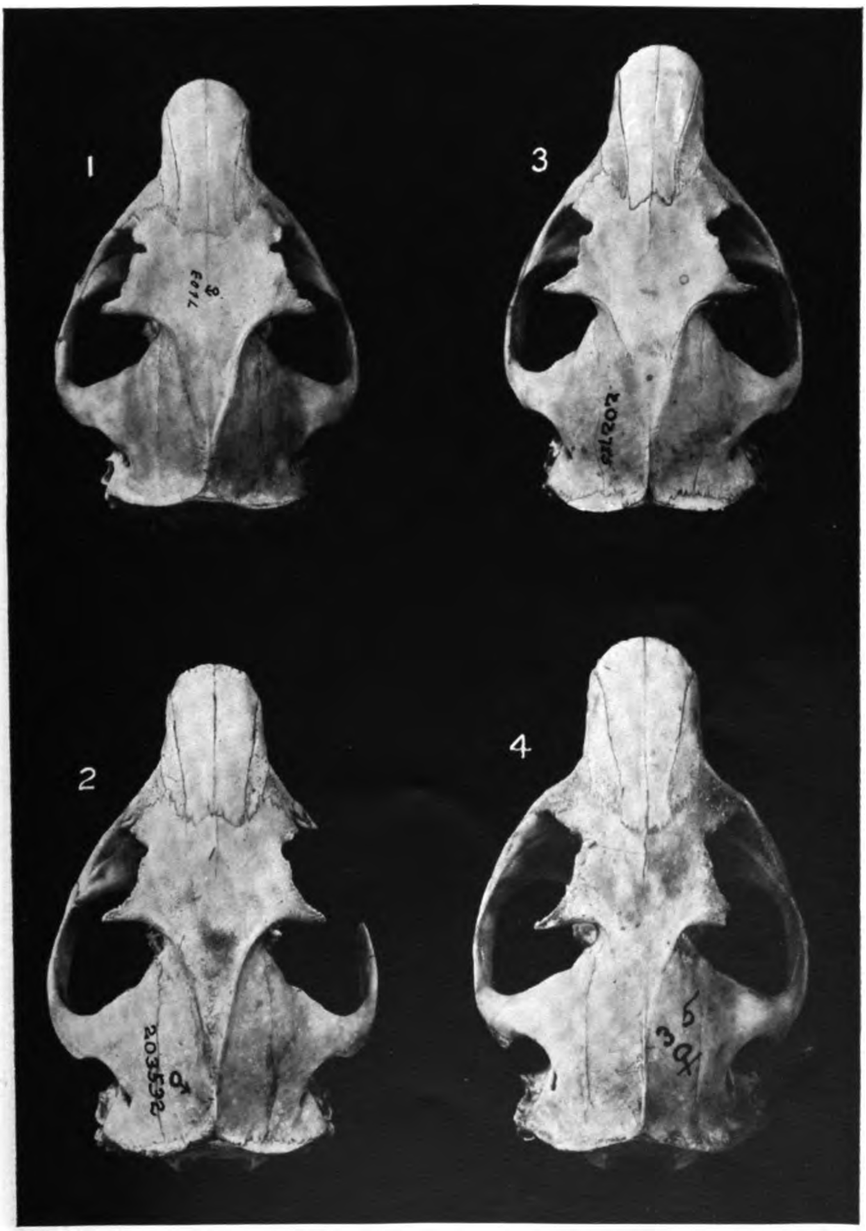
CRANIA AND MANDIBLES OF MARMOTA.

1. M. flaviventris dacota. 2. M. monax monax. 3. M. caligata oxytona. 4. M. flaviventris sierrae. 5. M. monax rufescens. 6. M. caligata caligata.



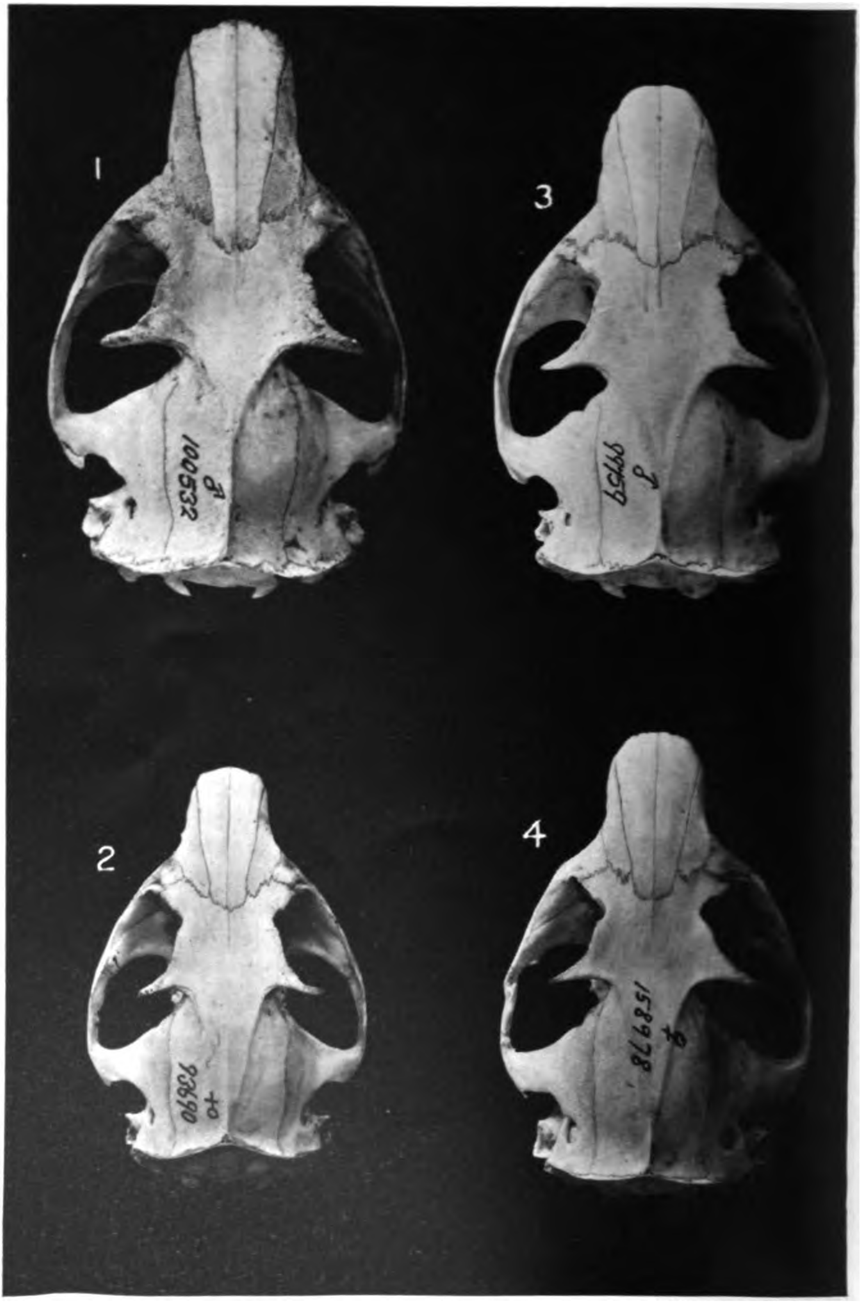
SKULLS OF MARMOTA.

1. M. monax monax. 3. M. monax preblorum.
2. M. monax rufescens. 4. M. monax ignava.



SKULLS OF MARMOTA.

1. M. monax canadensis. 3. M. monax ochracea.
2. M. monax petrensis. 4. M. flaviventris warreni.



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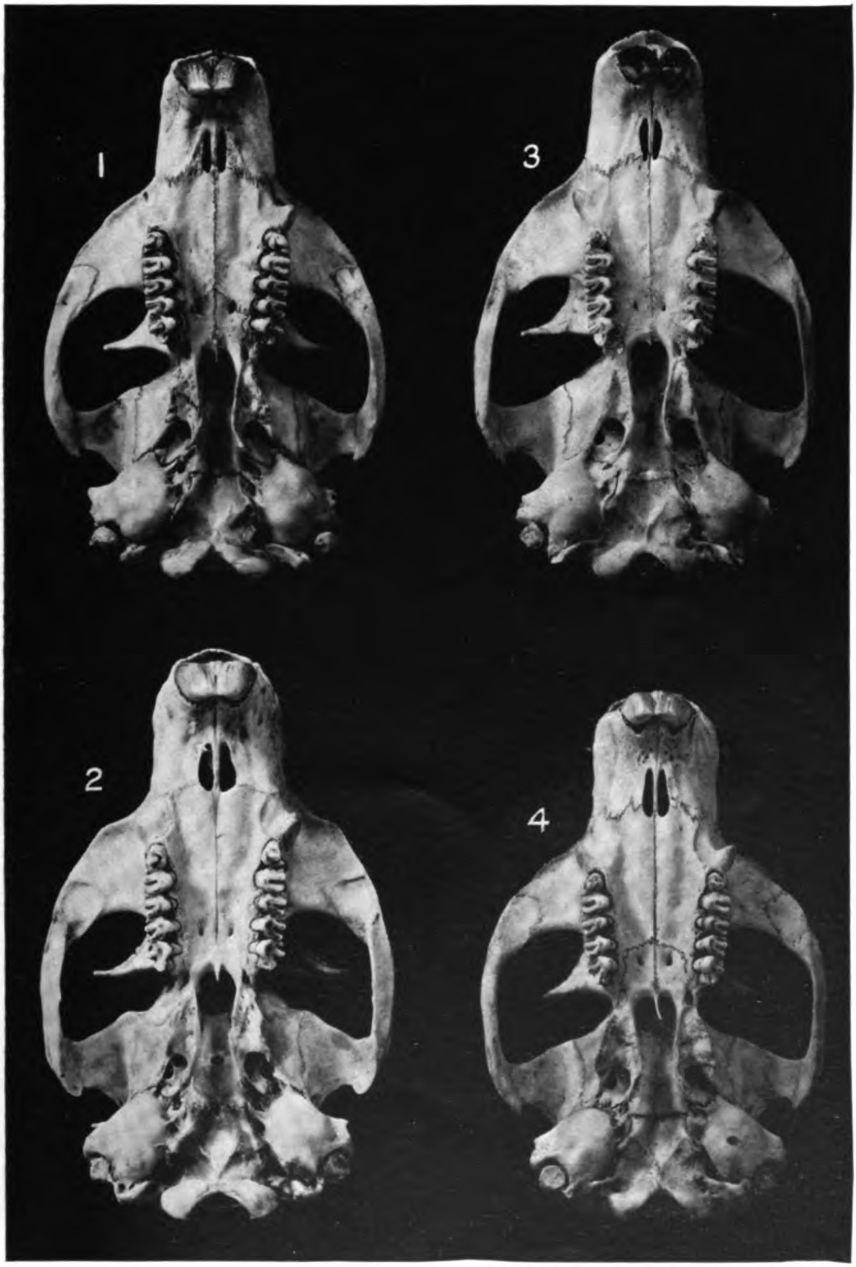
1. M. flaviventris flaviventris.
2. M. flaviventris parvula.
3. M. flaviventris avara.
4. M. flaviventris engelhardti.



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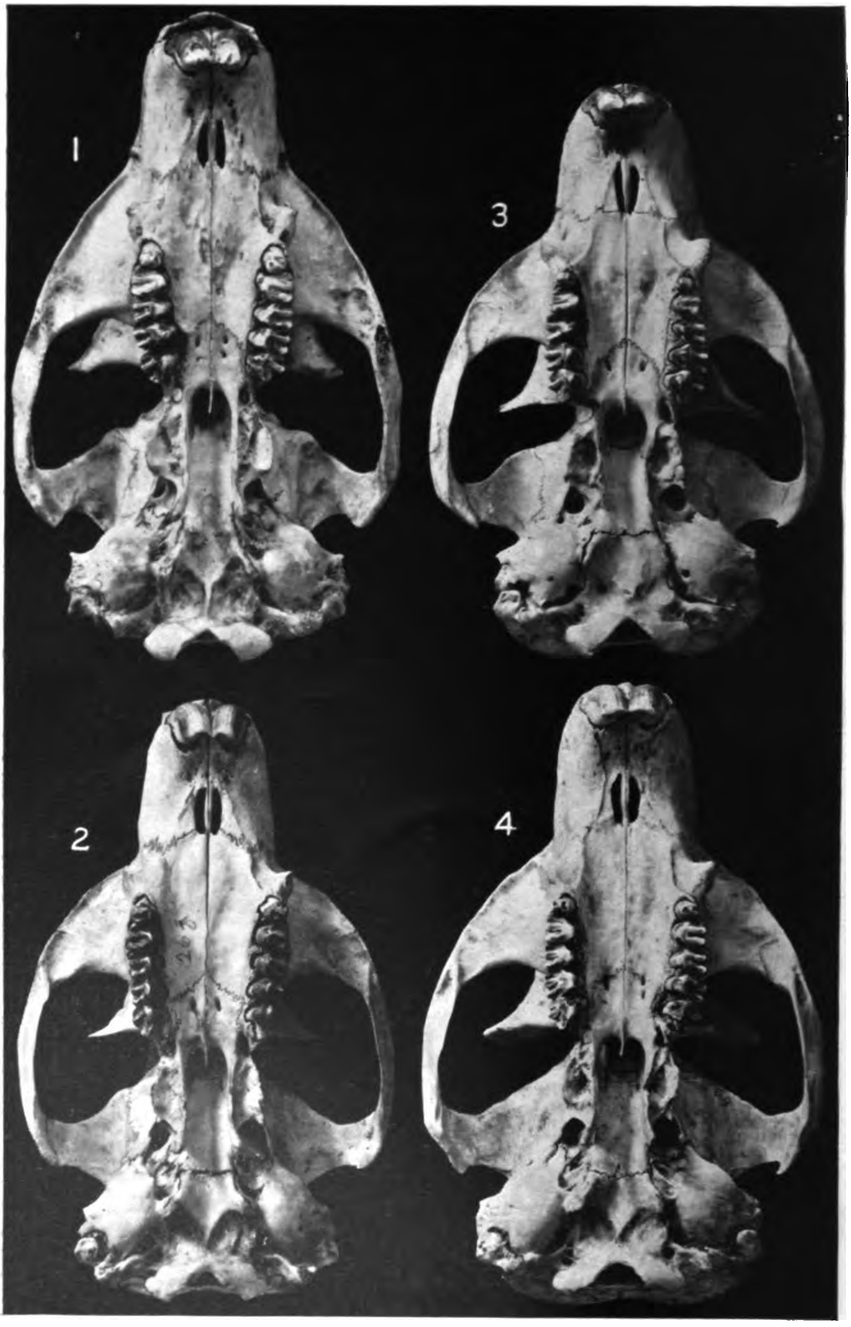
1. M. flaviventris nosophora. 3. M. flaviventris luteola.
2. M. flaviventris dacota. 4. M. flaviventris obscura.



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2. M. vancouverensis. 4. M. caligata cascadensis.

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[New names in bold-face type; synonyms in *italics*.]

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HENRY W. HENSHAW, *Chief*

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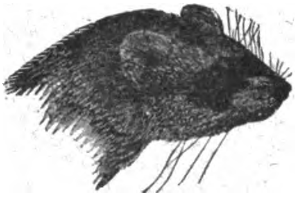

A REVIEW OF THE AMERICAN MOLES

BY

HARTLEY H. T. JACKSON
ASSISTANT BIOLOGIST, BIOLOGICAL SURVEY

WASHINGTON
GOVERNMENT PRINTING OFFICE
1915

LETTER OF TRANSMITTAL.

United States Department of Agriculture,
Bureau of Biological Survey,
Washington, D. C., March 26, 1915.

Sir: I have the honor to transmit herewith, for publication as North American Fauna No. 38, a review of the American moles by Hartley H. T. Jackson, assistant biologist, Biological Survey. Widely distributed throughout a large part of North America and very numerous in many places, moles have in some localities proved injurious to agriculture, though they are generally beneficial through their destruction of insects, which form much of their food. Their economic status has not yet been fully determined but is now being carefully investigated by this bureau, and for this work the present paper will serve as a basis.

Respectfully,

Henry W. Henshaw,
Chief, Biological Survey.

Hon. David F. Houston,
Secretary of Agriculture.

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A REVIEW OF THE AMERICAN MOLES.

By Hartley H. T. Jackson.

INTRODUCTION.

On account of their subterranean and secretive habits, American moles apparently were not observed by the earlier American explorers. As the settlement of the United States progressed, however, these animals became well known, and in many cases proved injurious to agriculture. Moles occur rather generally in eastern North America along the Atlantic and Gulf coasts from Labrador to Florida and in northeastern Tamaulipas, Mexico, and range westward to Manitoba and northeastern Colorado. Within this area are found three genera, *Scalopus*, *Parascalops*, and *Condylura*. All three genera occur in some localities, but no one covers the entire region occupied by the group. West of the area mentioned no moles are found until the Pacific coast region is reached. There, two other genera, *Scapanus* and *Neürotrichus*, occur, their ranges being confined mainly to the humid and semihumid region west of the Cascade Range and the Sierra Nevada, from southern British Columbia to northern Lower California.

In general, the several genera have the following distribution:

Scalopus, comprising the common naked-tailed moles of eastern United States, is the most widely distributed and best-known genus of the family. It ranges from southern Massachusetts, southern Ontario, central Minnesota, and northeastern Colorado south to the Gulf States and northeastern Tamaulipas, Mexico. It is confined almost entirely to the Upper and Lower Austral Zones.

Parascalops, comprising only a single species—Brewer's, or the hairy-tailed mole—is much more restricted in range than *Scalopus*, occurring from southern New Brunswick to northeastern Ohio, southern Pennsylvania, and south along the Appalachian Mountains to North Carolina. Although living in the midst of the range of *Scalopus*, in reality the two occur together at comparatively few places, since *Parascalops* is confined exclusively to the Transition and Canadian Zones, while *Scalopus* inhabits chiefly the Austral Zones.

Condylura, also comprising only a single species—the star-nosed mole—is widely distributed, but apparently not very abundant. It ranges from southern Labrador and southeastern Manitoba south to northern Illinois, along the Appalachian Mountains to western North Carolina, and on the Atlantic coast to Georgia. Apparently not limited in its distribution by zones, it occurs from the Boreal to the Lower Austral.

Scapanus fills the place on the Pacific coast occupied by *Scalopus* on the Atlantic slope, being abundant and widely distributed from British Columbia south to northern Lower California. It ranges through all the zones from Boreal to Lower Sonoran.

Neürotrichus has a limited distribution on the Pacific coast west of the mountains from southwestern British Columbia south to Monterey County, California, occurring in the Boreal and Transition Zones.

HABITS AND ECONOMIC STATUS OF MOLES.

While all American moles have certain general habits in common, as, for example, spending most of their lives underground and feeding largely upon insects, their habits vary in details. The genera *Scalopus*, *Scapanus*, and *Parascalops* usually inhabit drier soils, burrow deeper, and confine themselves more to subterranean runways than do *Condylura* and *Neürotrichus*. All moles prefer loamy or sandy soil where burrowing is easier, and consequently they are scarce or absent in heavy clay, stony, or gravelly soils. Insufficient food is often the cause of their scarcity in excessively sandy soils.

The common mole (*Scalopus*) is found in almost any area where soil and food are suitable; it is most plentiful in meadows, gardens, and similar habitats, but is by no means confined to them, and frequently is found in open woodland, along the banks of streams, and in other environments. It dwells in a series of subterranean tunnels 10 to 18 inches beneath the surface, and from these it forces to the outside small piles of earth, scarcely large enough to be worthy the name "molehills." A second series of tunnels is made just beneath the surface of the soil and appears as a series of small ridges, usually more or less branching and at times ramifying in all directions. This second series seems to be made chiefly during the animal's hunt for food and may be occupied but once; generally, however, the main surface tunnels are used for a considerable time. During dry weather the mole works deeper and practically deserts the surface ridges. Its change of habit is due in part to the increased hardness of the surface soil, but undoubtedly is more the result of its pursuing worms and insects into moister regions. Essentially the same condition is produced during winter, when the surface soil is frozen. The common mole seldom leaves its tunnels. Its nest is about 5 or 6 inches in diameter and usually 12 to 18 inches beneath the surface; most frequently it is placed under roots of shrubs or pasture grass and is made of grass and rootlets, but occasionally partly of leaves. In the northern half of its range the young are born during March or April; in the southern part they appear earlier in spring. The number of young in a litter varies from two to five, the usual number being four, and there is probably only one litter produced each year.

The habits of *Scapanus* are much like those of *Scalopus.* The ridges formed by *Scapanus* upon the surface are usually more conspicuous than those of *Scalopus,* and its "molehills," thrown up at frequent intervals, much larger. The hills made by *Scapanus* often contain a half bushel or more of dirt and resemble those made by the pocket gopher. The mounds made by *Scapanus,* however, show no trace of an opening, while those of the pocket gopher do. The mounds of *Scapanus* in most cases are more nearly circular than those of the pocket gopher. So far as known, the breeding habits of subspecies of *Scapanus latimanus* do not differ essentially from those of *Scalopus;* the time of breeding and the number of young in a litter are about the same. With *Scapanus townsendii,* however, the breeding time is later, the young usually being born during May or June. The number in a litter is less than with *S. latimanus,* there being usually only two or three, seldom four, and not infrequently only one.

The habits of *Parascalops* are not well known, but in general they appear to be much the same as those of *Scalopus.*

Star-nosed moles, genus *Condylura,* prefer to make their homes in wet meadows or marshes, though occasionally they may choose the same habitat as *Scalopus,* or even occupy the same tunnels with them. The surface ridges made by *Condylura* are more irregular and broken than those of *Scalopus* and usually smaller and more crooked; the burrows seem to be deep for a short distance, then appear as surface ridges, shortly to disappear again. Besides the subterranean tunnels, the star-nosed mole uses surface runways under and through the grass in marshes and meadows. Unlike other moles, *Condylura* frequently leaves its tunnels in winter and burrows in the snow, or even runs on top of it. Little is known concerning the nesting and breeding habits of this genus. A family of five young about one-third grown, collected May 22, 1888, by Morris M. Green, and now in the Biological Survey collection, was found in a nest under a log on the flats of the Potomac River a short distance north of Georgetown, D. C. Two of the young from this family are slightly more developed than the others, but it is not known whether this is due to difference in time of birth or to subsequent conditions. Another nest, containing young, is described by Bishop as follows:

> On May 22, 1890, while having some apple trees planted, I had the good luck to find a nest containing four young.
>
> The locality where the nest was found was two miles south of Kentville in Kings County, Nova Scotia. The land had been cleared of small forest trees several years before and had grown up with grass and was mowed every year.
>
> The particular spot where the nest was found was a little hillock or cradlehill which had been formed apparently by a tree having been blown down. When the roots had rotted away, a small dry mound of soft black sedimentary earth was formed, and in this the nest was built. This mound was high enough to be out of reach of storm water during wet weather.
>
> The elevation containing the nest was ten inches below the surface, and was made in circular form, seven inches in diameter. The nest was built of old dry grass, and was very compact and neatly made. Although the mound contained a complete network of roadways, no earth was thrown to the surface within ten feet of the nest.[1]

The little *Neürotrichus* prefers a damp habitat and is seldom found far from swamps, marshes, or streams. In the extreme southern part of its range it is most frequently found in swampy places overgrown with sedges or shrubs. Farther north its habitat is less confined, and it is found along streams or even in moist dense woods. Its tunnels are more like those of *Condylura* than other moles, and it seems to spend no small part of its time in surface runways or under logs. In fact, the tunnels are often open above for some distance, and in this respect resemble the tunnels of the eastern pine mouse (*Pitymys pinetorum*). The nesting and breeding habits of *Neürotrichus* are unknown.

The economic status of American moles has been the subject of much dispute, authorities differing as to whether the animals are beneficial or harmful. The genera *Parascalops*, *Condylura*, and *Neürotrichus* are local in distribution, seldom abundant in any locality, and most frequently inhabit waste or uncultivated lands; they can not, therefore, have extensive economic importance. Such is not the case, however, with *Scalopus* and *Scapanus*, which are more generally distributed throughout their ranges, and usually abundant in lawns, fields, and gardens. The food of moles consists in large measure of insects, and in this they are beneficial. However, moles destroy large numbers of earthworms, make unsightly ridges in lawns, and dig tunnels which permit incursions of rodents injurious to roots, tubers, and planted seeds, and which frequently are directly responsible for the weathering away of humus deposits and supersoils on hillsides; in these activities moles are harmful. The economic status of the mole is being extensively investigated by Theodore H. Scheffer, under the direction of the Biological Survey; the results of his studies will be published later.

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[1] Bishop, W. L., Trans. Nova Scotia Inst. Sci., vol. 10. pp. 348-349, October 1, 1902.

CHARACTERISTICS AND DEVELOPMENT OF THE YOUNG.

The young of *Scalopus* (Pl. I, fig. 3) are born hairless. Vibrissæ very soon appear on the lips, but hair does not show until the animal is at least a week or ten days old. The fresh, first pelage remains short and grows little until the animal is nearly one-third grown; it is exceedingly fine and silky, and lies close to the body, giving the animal a smooth, sleek appearance. Two young,[1] probably about a week old, from Jackson, N. C., have the general proportions of the body much as in adults. The feet, both fore and hind, have much the same shape as in adults, and are relatively about the same size, though, on account of the bones of the arm thickening rather than lengthening during growth, the fore feet of the young, being relatively more projected from the body, appear at first glance to be relatively very large. The hind feet are relatively a little wider than those of adults. The claws of the fore feet are soft and weak, though relatively thick and broad; those of the hind feet are very soft and only slightly developed. The external ear appears as a thickening of the dermis into a flat papilla 1.5 mm. in diameter. The center of this is penetrated by a minute auditory opening that seems to be closed by the contact of its sides; as an auditory organ its function is probably exceedingly limited. The rudimentary eye appears as a small pigmented spot covered by dermis; a minute, imperfect opening passes through the dermis to the eye proper, and may be sufficiently penetrable for the animal to perceive light from darkness; it seems improbable, however, that the eye is sufficiently developed for form perception, and it is probable that with advanced age the sense of light perception becomes less acute.

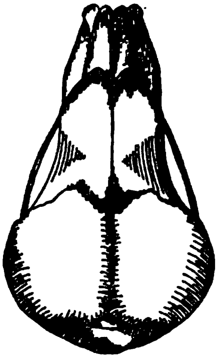

FIG. 1.—Skull of young of *Scalopus aquaticus machrinoides* (× 3). [Reconstructed and drawn by the author from specimens Nos. 5899 and 5900, Field Mus. Nat. Hist.; from Greenway, Ark.]

Skulls of young (fig. 1) a week or ten days old distinctly show the sutures between the principal cranial bones; the sutures between the frontals and parietals, however, are now nearly closed. In comparison with skulls of adults, the mastoid region is high and swollen and the zygomata are heavy. The auditory meatus is distinct and more pronounced than in adults, the bullæ small, but relatively high and rounded and not so much flattened. The nasals are short and broad, becoming wider posteriorly; the premaxillæ are triangular, adjoining the anterior two-fifths to one-half of the nasals. During the development of the skull the premaxillæ push forward and gradually enclose the nasals anteriorly. Most of the cranial bones are anastomosed and the sutures closed before permanent dentition is acquired. The suture between the interparietal and the parietals is the last to close and is the only one which may remain open and distinct in extreme old age. The sutures between the premaxillæ and the maxillæ and those between the nasals and the maxillæ usually remain indistinctly visible until permanent dentition is acquired.

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[1] Alcoholic, No. 7250, U. S. Nat. Mus.

The writer has examined no very young moles of genera other than *Scalopus*, but it would seem that the general relationships of characteristics of young to those of adults would be essentially the same in the different genera. Bishop, writing about *Condylura*, states: "The young were probably ten days old, the fur just beginning to start, which gave the skin a dark brown colour."[1] The most remarkable difference between young and adults of *Condylura* is in the snout. The character of that organ in the young has been well described by Ayres, as follows:

> At birth the star-nosed mole is nearly destitute of visible hair and the tactile bristles of the facial region have not made their appearance at the surface. The snout of the young *Condylura* lacks all the distinctive characteristics of the adult, and the entire body resembles that of *Talpa* much more than it does its parent. On a close examination of the distal end of the snout of such a new-born animal one can distinguish a tract of skin which covers four-fifths of the circumference of the organ (the part not specially marked off is the median ventral fifth). This dermal tract extends for three millimeters toward the base of the snout and is marked off from the remaining surface by a series of furrows running parallel to the long axis of the body. A series of parallel ridges is thus formed, each ridge being bounded on either side by a furrow. At their anterior and posterior ends these ridges pass gradually into the neighboring smooth surface. By a gradual ingrowth of the bottoms of the furrows each groove is deepened and each ridge suffers a correspondingly increased definition of form, while at the same time the posterior end of each groove grows toward its neighbor on either side. When the grooves have all united there is formed by their union a common groove which nearly encircles the snout and separates the tactile from the remaining surface of that organ.
>
> Commencing at the posterior margin of the tactile surface and advancing toward the tip of the snout, the grooves deepen and grow toward each other in their bottom portions until they finally coalesce underneath the ridges. The result of this process is the production of free, finger-shaped processes composed exclusively of ectoderm, attached to the anterior end of the snout in the manner already described for the adult.[2]

The pelage of individuals of *Scapanus*, *Parascalops*, and *Condylura*, one-third grown, has much the same compact, sleek appearance as that of *Scalopus*, indicating a slow and probably entirely postnatal growth.

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[1] Bishop, W. L., Trans. Nova Scotia Inst. Sci., vol. 10, p. 349, Oct. 1, 1902.

[2] Ayres, H., Biol. Centralb., band 4, pp. 358-359, 1885.

PELAGES AND MOLTS.

The hair of all American moles is fine and silky, producing a soft and velvetlike pelage. In *Scalopus*, *Scapanus*, and *Parascalops* the hairs are nearly equal in length and there is no distinct underfur. In *Condylura* some of the hairs are distinctly longer and coarser than the major portion, the latter forming an underfur, and the whole producing a pelage much less velvetlike than that of any other genus. In *Neürotrichus* the condition of the pelage is somewhat as in *Condylura;* the fur is shorter, however, and the underfur difficult to detect.

The basal pelage reveals a series of transverse vermiculations, most pronounced in *Scalopus* and *Scapanus*, least in *Neürotrichus;* in all genera these markings are more noticeable in the fur on the back, less on the ventral parts. Microscopic examination shows that these vermiculations are due to structural as well as chromatic differences. Each hair consists of normally pigmented, gray, cylindrical sections, 1 to 2 mm. long, alternated with finer flat sections, 0.2 to 0.5 mm. long and unpigmented, or with the pigment reduced to a small amount of yellow. Each one of these fine, flat sections acts as a hinge upon which the hair bends; this in part produces the velvetlike texture of the pelage and permits the hair to be rubbed either forward or backward with little friction—a distinct advantage to a subterranean mammal. The vermiculations usually show more clearly in worn pelage than in fresh. The young of *Scalopus*, *Scapanus*, and *Parascalops*, in their first winter pelage, are more grayish than adults; of *Condylura*, paler and more brownish. Winter pelage of adults of all moles is usually darker than that of summer; worn pelage is faded and frequently more brownish than the fresh. The color of specimens retained in a cabinet or storage case for a few years usually fades, becoming more brownish than that of recently killed animals.

TIME OF MOLTING.

There are two molts annually in *Scalopus*, one in spring and the other in fall. Throughout most of the range of the genus the spring molt is usually completed by the last of May or the first of June; the fall molt, in the northern half of the range, by the first week in October; in the southern part of the range the fall molt naturally occurs later in the year, and the spring molt earlier than farther north. The winter pelage of breeding females becomes worn early in the season, but, as has been suggested by True,[1] the actual molting in such individuals may frequently be delayed. Examination of a large series of specimens from Washington, D. C., shows that the spring molt in that region occurs usually during the months of April and May, though most of the animals are probably in full summer pelage by the middle of May. A large series of specimens from the same locality, taken during October and the first part of November, are all in full winter pelage; the fall molt seems to take place there during the latter part of August and the first half of September. Specimens of *Scalopus aquaticus machrinus* from northern Illinois show molting during the first half of May; one taken June 15, 1907, at Joliet, Ill., is in fresh summer pelage, except for a small place on the face; in a topotype of *S. a. machrinus* collected September 5, 1898, the ventral parts are in short, fresh, winter pelage, the dorsal parts in old, summer pelage. Specimens of *S. a. pulcher*, taken at Delight, Ark., the middle of September, are in nearly complete winter fur; an adult male taken April 30, 1910, at Lake City, Ark., is in fresh summer pelage except on the nose; specimens taken at Sour Lake, Tex., the latter part of March and first of April, 1905, show the beginning of molt on the underparts. The spring molt of *S. a. australis* seems to occur from about the middle of March to the middle of April. A topotype of *S. a. texanus*, collected February 9, 1893, has fresh summer pelage on the abdomen.

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[1] True, F. W., Proc. U. S. Nat. Mus., vol. 19, p. 37, 1896.

The time of molting seems to be more irregular in *Scapanus* than in *Scalopus*, and the period of seasonal molt during which numbers of individuals may be found molting is more prolonged than with *Scalopus;* it is possible that this difference may be correlated with climatic differences. The spring molt in *Scapanus latimanus latimanus* may commence any time from the middle of January to the last of April; specimens in which the spring molt has just begun were collected at Santa Cruz, Cal., January 14 and February 28, and at Red Bluff, Cal., April 24; one collected at Lower Lake, Cal., April 12, still retains the worn and faded winter pelage; a specimen collected March 13, at Santa Cruz, is in fresh summer pelage, and the majority of specimens show this condition by the middle of April. The autumnal molt of *S. l. latimanus* may begin from the middle of August to the last of November; in a male collected August 14, at Santa Cruz, the molt is well begun; a specimen taken November 30 at Fort Bragg, Cal., has fresh pelage on the head only, and another taken the same day at King City, Cal., has obtained about one-third of its new pelage; in most cases, however, the winter pelage is complete by the last of November. The autumnal molt in *S. l. dilatus* is usually completed a month earlier than in *S. l. latimanus*, though one specimen collected at Chico, Cal., December 20, has just started to molt. A female collected August 4, at Round Mountain, Cal., is about two-thirds covered with fresh pelage, and is probably in a delayed spring molt. The specimens of *S. l. occultus* examined indicate that the spring molt in that form may begin as early as the first of January or as late as the latter half of June; a specimen in which the molt is just begun was collected January 2 at Somerset, Cal., and a male in similar condition of molt was taken at Alhambra, near by, on June 21; spring molt in *S. l. occultus* is usually completed by the first of April and the autumnal molt about the first of December. The material available does not show many specimens of *S. townsendii* in process of spring molting; two collected April 7, 1914, at Puyallup, Wash., are in nearly complete summer pelage, while in three others the molt is fully complete. The majority of specimens show full summer pelage the latter part of April. The fall molt of *S. townsendii* occurs most frequently during October; specimens occasionally show molting later in the year, as, for example, one collected December 20, 1912, at Ferndale, Cal., which shows the last remnants of summer fur; on the other hand, the fall molt may begin as early as the latter part of August; several females collected during July and the first half of August, near Portland, Oreg., are in various stages of molting from the beginning to half complete, which may be a delayed spring molt. A specimen of *S. orarius orarius* collected March 11, 1913, at Ferndale, Cal., has begun to molt; one of *S. o. schefferi* collected at Lester, Wash., May 14, 1914, shows only a trace of old pelage on the back and underparts; others secured the middle of May are in full summer pelage. The change to winter pelage in *S. o. orarius* seems to occur mostly during October, though a male taken at Eureka, Cal., August 17, 1910, shows the beginning of the autumnal molt.

Material examined is insufficient for a satisfactory determination of the time of molting of *Parascalops;* in a male from Magnetic City, N. C., collected March 26, 1894, the ventral parts and the rump are in fresh summer pelage, the rest of the fur being worn winter pelage; other specimens in various stages of molt from the same locality were taken between April 24 and July 5. Many specimens collected at various localities during August and September show a much-worn pelage; it seems probable that winter fur appears during October and November; in fact a specimen collected October 12, 1910, in Wetzel County, W. Va., has traces of a new pelage under the old on the breast. An adult male from Magnetic City, N. C., collected August 21, 1893, shows molting and has the entire ventral parts in fresh pelage; it is impossible to determine whether this is an early fall molt or a delayed spring molt.

The spring molt in moles of the genus *Condylura* occurs late, the molting process being at its height during June and the first half of July, though it is usually completed by the middle of the latter month; very rarely molting may begin during the last few days of May, and, equally as rarely, traces of winter pelage may remain well into August. The autumnal molt of *Condylura* takes place during October, though occasionally it begins the last of September; the full winter pelage is usually obtained before the last of October.

In a large series of *Neürotrichus* from Sumas, British Columbia, the spring molt appears to be at its height during the latter half of May and the first week of June, though one or two specimens indicate a beginning of the molt as early as the latter part of April; most individuals are in full summer pelage by the first of July; none of these specimens show autumnal molt. Farther south, in Washington, Oregon, and northern California, spring molt is earlier, and specimens taken there during the first part and middle of June are in summer pelage. The available material has been insufficient to determine the time of the fall molt, though apparently it occurs during October. A specimen from Goldbeach, Oreg., collected September 21, 1901, has a trace of new pelage under the old on the breast; two from Steilacoom, Wash., October 9 and 12, 1891, and one from Palo Alto, Cal., October 17, 1897, have the molt well advanced; a male taken October 18, 1891, at Tenino, Wash., is in nearly complete winter pelage.

MANNER OF MOLTING.

Molting in *Scalopus* occurs more or less regularly in definite sequence on the different parts of the body, and the same order is followed in both the vernal and autumnal molts. The fresh pelage first appears on the breast and abdomen (Pl. I, fig. 1) and gradually replaces the old until the entire underparts, except the chin and throat, have molted; at this stage there is a sharp lateral line of demarcation between the new and the old fur (Pl. I, fig. 2); the fresh pelage gradually extends up over the back, generally encroaching upon the posterior part first and working forward toward the nose. The chin and throat in most individuals retain the old pelage for several days after all the rest of the molt is complete. There are, of course, exceptions to this general order of molting but most of these occur in animals which are molting either earlier or later than normally, and the writer is inclined to believe that these variations are either due to retarded or stimulated physiological processes, or else result from injuries to the animal. Two specimens show distinctly that the molting process has been retarded on account of injuries; one[1] is in full winter pelage except a very small place on the throat and a small patch directly posterior to a flesh wound on the left side of the posterior part of the back; the other[2] is in complete winter pelage except a circular patch, about 20 mm. in diameter on the occiput, which is also mostly posterior to a flesh wound and partly encloses it; winter pelage surrounding the patches is in both specimens long and well developed, in marked contrast with the short fur of delayed growth. A male[1] from Connecticut, in somewhat premature molt, has the entire dorsal parts in fresh pelage except a patch about 30 mm. in diameter on the right shoulder; the anterior three-fifths of the ventral parts are in old pelage, and this extends well up the sides. A postbreeding female,[2] the molting of which has already been mentioned by True,[3] is in retarded, much-worn winter pelage, except the posterior half of the back, anterior to the rump, and a very small portion of the abdomen, which are in rather incomplete spring pelage.

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[1] No. 180769, U. S. Nat. Mus., Biological Survey collection; ♂ adult, collected at Washington, D. C., October 11, 1912.

[2] No. 6190, Acad. Nat. Sci. Philadelphia; ♀ adult, collected at Audubon, N. J., October 28, 1906.

The sequence of molting in *Scapanus* is less definite than in *Scalopus*. The differences of color, texture, and length of hair between the old and new pelages of *Scapanus* are usually slight; often the line of demarcation separating the two pelages is scarcely distinguishable, and seldom sharp as in *Scalopus*. The sequence of molting on the various parts of the body appears in a few cases to be not unlike that of *Scalopus*, the underparts molting first, followed consecutively by the sides and back. More frequently, however, the new pelage appears first on the head and throat, then works down over the nape and back, encroaching last upon the abdomen; or, as is shown most beautifully in a specimen[4] of *Scapanus latimanus latimanus* from Petrolia, Cal., the new pelage may appear simultaneously in separate patches upon head, back, and rump.

The material has been inadequate to show anything definite regarding the method and sequence of molting in *Parascalops*, but the specimens examined seem to indicate that these processes are not unlike corresponding processes in *Scalopus*.

The new fur of *Condylura* generally appears first on the posterior part of the flanks, but the body sequence is inconstant; the molt on the flanks usually spreads forward and ventrally, while at the same time on the back fresh pelage replaces the old, which sloughs off in irregular blotches. Probably in most cases the ventral parts are in fresh pelage before the major portion of the back has molted; a small posterior rump patch is almost invariably the last to molt. The contrast between new and old pelages during the spring molt is marked; the autumnal molt, however, is often difficult to detect.

In the genus *Neürotrichus*, new pelage ordinarily first replaces the old on top of the head; this is soon followed by the molting of the posterior part of the back almost simultaneously with the beginning of the molting of the ventral parts on the throat and breast; the molting areas on the back increase in size and finally enclose each other; the area on the breast works posteriorly, then dorsally; the flanks are the last to molt. The molting process in *Neürotrichus*, once well begun, seems to be very rapid, and this may account for the sparsity of material of this genus showing molt.

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[1] No. 4276, Mus. Comp. Zool., Bangs collection; ♂ adult, collected Februrary, 21, 1896, at Liberty Hill, Conn.

[2] No. 22658, U. S. Nat. Mus., Biological Survey collection; collected July 1, 1888, at Washington, D. C.

[3] True, F. W., Proc. U. S. Nat. Mus., vol. 19, p. 37, 1896.

[4] No. 140706, U. S. Nat. Mus., Biological Survey collection; ♂ adult, collected Nov. 6, 1905.

GEOGRAPHIC VARIATION.

The maximum of geographic variation occurs in *Scalopus* and *Scapanus*. In *Scalopus* it consists in general of a decrease in size toward the south and an increase in pallor toward the west. The maximum size of individuals is found in the north-central part of the range of the genus; the size decreases gradually both to the east and west, and rather abruptly toward the south. The rostrum tends to shorten in the western and southwestern portions of the range. The palest members of the genus are found in the region of western Nebraska; the color darkens toward the east and south, becoming somewhat ochraceous in the southwestern part of the range.

The size of *Scapanus* (except in *S. townsendii* and *S. orarius orarius*), like that of *Scalopus*, decreases toward the south. In the coast region the pallor increases toward the south, and reaches its maximum in specimens of *Scapanus latimanus occultus* from San Diego County, Cal.; farther south, however, in the San Pedro Martir mountain region of Lower California, the color of *Scapanus* seems to become darker again. In the interior, more mountainous regions, the color of *Scapanus* becomes darker toward the south, the darkest specimens being from Yosemite Valley, Cal., while the palest are from Crater Lake, Oreg., and the Mount Shasta region, Cal.

Geographic variation in *Neürotrichus* manifests itself in a slight increase in size and a very slight darkening of color in the southern part of the range. A tendency appears also for the more pronounced development of an anterior cusplike process on the cingulum of the second upper premolar in specimens from the southern half of the range of the genus.

Geographic variation in *Parascalops* and *Condylura* is negligible, though a slightly decreasing size southward is noted in *Condylura*.

INDIVIDUAL VARIATION.

The general size, shape, and proportions of skulls of moles, conspecific and of corresponding maturity, from any given locality are usually constant, variation seldom exceeding more than 4 per cent. On the other hand, the shape of individual cranial bones is noticeably variable, especially that of the interparietal. In a series of specimens of *Scalopus* from a given locality the posterior border of the palate may be simple, spined, or notched; in *Scapanus*, simple, but usually notched; in *Condylura* usually simple, but sometimes spined; and in *Parascalops* and *Neürotrichus*, almost invariably simple. There is a marked tendency in *Scalopus* and *Scapanus* toward abnormal dentition; this appears not only in the production of accessory cusplike processes on the cingula of the premolars, but also in the increase or reduction of the number of premolars ordinarily present. The tendency in *Scalopus* is toward extra premolars; in *Scapanus* it is toward the suppression of premolars, though in each of at least seven skulls examined there is a supernumerary premolar.

The general color of specimens from a given locality is constant, except for seasonal variations. Individual abnormalities, however, occur frequently in *Scalopus* and *Scapanus*. The common type of chromatic variation in *Scalopus* is the occurrence of white, cream, orange, or ochraceous spots or blotches, appearing usually either on the face or on the ventral parts. Scheffer[1] has remarked upon the prevalence of this form of variation in *Scalopus* at Manhattan, Kans., where he finds that certain regions of the body of a large majority of the moles taken are washed with a tinge of orange, or that on the head or abdomen are distinct patches of this color. Variations similar to these, however, crop out in many localities. They are not confined to any particular species or subspecies, but appear most frequently in *S. a. machrinus* and *S. a. machrinoides*. In many specimens this form of variation is, apparently, partial albinism, the patches being nearly white and the slight creamy or brown tinge probably being due to glandular or other stains. Blotches in other specimens range from cream color to shades of buff, orange, and brown, and show clearly that they are due to mutations of color. A unique variation occurs in a specimen from Warsaw, Ill. (No. 5429, American Museum of Natural History). The entire underparts of this animal, except the vent and right hind foot, are a beautiful capucine buff, as are also the nose and right side of the face; a narrow band of this color extends for a short distance up the posterior part of each flank, and anteriorly another band passes over the shoulders and across the nape, forming a complete collar; the remaining dorsal parts are much as in normal specimens, but perhaps slightly more vinaceous. Another peculiar variation occurs in a specimen from Madison, Ind. (No. 112008, United States National Museum). The entire dorsal parts of this individual are normally colored; the ventral parts are pale ochraceous-salmon to ochraceous-buff, irregularly spotted and blotched especially laterally with grayish fuscous, the whole effect reminding one in certain respects of the ventral parts of some of the spotted tiger-cats or ocelots.

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[1] Scheffer, T. H., Kansas State Agr. College Exp. Sta. Bul. 168, p. 4, 1910.

That these chromatic mutations are inherited in Mendelian ratio among the offspring is strongly suggested in the specimens examined from Point Pelee, Ontario. From the small and somewhat isolated colony of *Scalopus* inhabiting this locality 25 specimens collected between October 18, 1908, and June 2, 1913, have been examined. Of these specimens 18 have ochraceous patches on the face, while the remaining 7 are normally colored. On purely unsubstantiated evidence, it would appear that "lack of gray-producing pigment" is here a dominant character, and that the hereditary tendency is probably toward pattern development rather than toward the primitive mammalian monochromatic grayish coloration.

Mutations of color seem to occur less frequently in *Scapanus* than in *Scalopus*; they are most marked in specimens of *Scapanus orarius schefferi* from Walla Walla and Wenatchee, Wash. Abnormalities in color in the genera *Parascalops*, *Condylura*, and *Neürotrichus*, are confined to albinistic spots which occur only rarely and usually appear to have been caused by injuries.

The writer has seen no melanistic specimens of American moles.

SEXUAL VARIATION.

The only marked sexual variation in American Talpidæ is in size of individuals. This is very noticeable in *Scalopus* and *Scapanus*, in which genera males are considerably larger than females. The same condition probably holds in other genera; in the specimens examined of *Parascalops*, *Condylura*, and *Neürotrichus* there is no apparent sexual variation, but this may be due to incorrect determinations of sex.

AGE VARIATION.

The most characteristic change in American Talpidæ occurring with increasing maturity is a flattening of the skull and a broadening of the base of the rostrum. These tendencies prevail in all genera. Broadening of the base of the rostrum is due to lateral thickening of the maxillæ. In immature specimens the external roots of the molars are not infrequently exposed in places through the maxillæ. In all genera except *Condylura* the upper premolars tend to become less cuspidate with increasing age, due not alone to wear of the teeth, but apparently to absorption and physiological processes.

The genus *Condylura* furnishes an anomalous and unique age variation; old adults possess a distinct median longitudinal crest on the upper posterior half of the rostrum. Another peculiar variation accompanying age occurs in *Parascalops* in which the hair on the nose and tail frequently turns white in old adults.

SEASONAL VARIATION.

Winter pelage of most moles is slightly darker than that of summer. No other seasonal variations occur except in *Condylura:* The tail of *Condylura* during the summer months is narrow and elongate; during the winter months it becomes much thickened, abruptly constricted at the base, and tapered apically. Both males and females have been found with tails in both conditions. The variation probably is due to assimilation of fat. Enlargement of the tail may begin as early as August, but usually it does not begin until September, or possibly later; the maximum size is reached in most cases by the latter part of November and is retained until March or April, when the tail gradually diminishes to its minimum summer size by the last of May or the middle of June.

EXPLANATIONS.

EXTERNAL MEASUREMENTS.

External measurements of moles are in millimeters and, unless otherwise stated, are those made by the collector from the animal in the flesh. The following have been used:

Total length.—Tip of nose to end of terminal tail vertebra.

Tail vertebræ.—Base of tail at upper surface to end of terminal tail vertebra.

Hind foot.—Heel to end of longest claw.

CRANIAL MEASUREMENTS.

Cranial measurements were made by the author with a vernier caliper. The following have been employed:

Greatest length.—Antero-posterior diameter of skull from anterior median point between bases of first upper incisors to most posterior point of supraoccipital in median line.

Palatilar length.—Antero-posterior diameter of palate from posterior median point between bases of first incisors to posterior median border of palate.

Mastoidal breadth.—Lateral diameter of skull measured through mastoids. Greatest lateral diameter of skull.

Interorbital breadth.—Lateral diameter of cranium measured at coronal suture.

Maxillary tooth row.—Antero-posterior diameter of upper molar-premolar row measured at alveolar border.

Mandibular molar-premolar row.—Antero-posterior diameter of lower molar-premolar row measured at alveolar border.

The bone immediately anterior to the lambdoidal crest and just posterior to the parietals is here called the "interparietal." This bone in moles has been considered by some writers part of the supraoccipital.

COLORS.

The names of colors used throughout the text are those of Ridgway.[1] On account of iridescence and reflection of light from the fur the color of any single animal may appear to vary considerably when viewed from different angles. For this reason the following method of making comparisons and observations of colors was used consistently: Diffused daylight from a window was allowed to strike the animal at an angle of 30° to 45° posterior to a plane perpendicular to the median longitudinal line of the animal. The mole was then viewed from its anterior end at an angle of about 60° from the light rays and in the same plane with them. In spite of this care colors have sometimes been exceedingly difficult to determine and describe.

MATERIAL AND ACKNOWLEDGMENTS.

The present revision recognizes 28 forms of 10 species of American moles and is based upon a study of 2100 specimens, mostly skins accompanied by skulls. Of this number, *Scalopus* comprised 945, *Scapanus* 604, *Parascalops* 129, *Condylura* 218, and *Neürotrichus* 204. While type specimens or essential topotypes of all described forms have been examined, the material has been inadequate for an entirely satisfactory understanding of the group, and this is particularly true of the genus *Scapanus*, and of *Scalopus* from some of the southern and western parts of its range. Unreliable determinations of sex also have been a serious handicap.

Although the study has been based primarily upon specimens in the Biological Survey and other collections in the United States National Museum, including the Merriam collection, it became evident early in the investigation that this material would be insufficient for a proper elucidation of the group. Accordingly specimens were borrowed from various museums and private collections until nearly all that were available in the United States and Canada were examined. For the loan of specimens and for various other courtesies I wish to express my appreciation to the following: Dr. J. A. Allen, of the American Museum of Natural History; Mr. Samuel Henshaw and Mr. Outram Bangs, of the Museum of Comparative Zoology, Harvard College; Dr. Joseph Grinnell, of the Museum of Vertebrate Zoology of the University of California; Mr. Charles B. Cory and Mr. W. H. Osgood, of the Field Museum of Natural History; Dr. Witmer Stone, of the Academy of Natural Sciences of Philadelphia; Dr. W. J. Holland and Mr. W. E. Clyde Todd, of the Carnegie Museum; Mr. H. L. Ward, of the Public Museum of the City of Milwaukee; Dr. A. G. Ruthven, of the University of Michigan Museum

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[1] Ridgway, R., Color Standard. and Color Nomenclature, 1912.

of Zoology; Mr. P. A. Taverner, of the Victoria Memorial Museum, Ottawa, Ontario; Mr. Stanley G. Jewett, of the Oregon State Game Commission; Dr. Charles H. Gilbert, of Stanford University; Mr. Myron H. Swenk, of the University of Nebraska; Mr. W. H. Over, of the University of South Dakota; Mr. H. E. Anthony, Mr. D. E. Kent, Mr. G. L. Kirk, Mr. W. E. Saunders, and Mr. Thaddeus Surber. The writer is also indebted to Mr. Gerritt S. Miller, jr., and Mr. N. Hollister, of the United States National Museum, and Dr. M. W. Lyon, of the George Washington University, for many courtesies and suggestions. The text drawings, with the exception of figure 1, are the work of Miss Ruth Gibson Collette.

THE FAMILY TALPIDÆ.

The family Talpidæ, exclusive of fossil forms, is composed of thirteen genera peculiar to the temperate regions of the Northern Hemisphere.[1] Five of these (*Scalopus*, *Scapanus*, *Parascalops*, *Condylura*, and *Neürotrichus*) are indigenous to North America. *Scapanus* and *Neürotrichus* are found only on the Pacific slope; *Scalopus*, *Parascalops*, and *Condylura*, only in the Atlantic drainage. The family is a rather heterogenous group which, in certain genera, has characters in common with other families of Insectivora. The characters taken in combination, however, are diagnostic. The nearest relationships of the family are with the Soricidæ, which are approached most closely in the Thibetan genus *Uropsilus*. The American Talpidæ, however, are distinct from any of the American Soricidæ and may be distinguished by the following characters:

AMERICAN TALPIDÆ (MOLES).	AMERICAN SORICIDÆ (SHREWS).
Ear-conch absent.	Ear-conch present (small and inconspicuous in *Blarina* and *Cryptotis*).
Clavicle short and broad.	Clavicle long and slender.
Humerus short and broad (length less than twice the width).	Humerus relatively long and slender (length more than twice the width).
Pelvis relatively narrow (length more than thrice the width).	Pelvis relatively broad (length less than thrice the width).
Os falciforme present on the fore foot (rudimentary and indistinct in *Neürotrichus*).	No os falciforme on the fore foot.
Terminal phalanges of fore feet bifurcate.	Terminal phalanges of fore feet simple, not bifurcate.
Zygomata present.	Zygomata absent.
Audital bullæ present, complete or incomplete.	Audital bullæ absent.
Exterior pterygoid region rotund and much inflated.	Exterior pterygoid region angular and not inflated.
First upper incisor flat, without elongated crown.	First upper incisor not flat, with very elongated crown.

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[1] A closely related family, Chrysochloridæ, is found in central and southern Africa.

SUBFAMILIES.

Several mammalogists have undertaken to divide the Talpidæ into groups or subfamilies. The most recent classification of this sort is that of Thomas,[1] who divides the family into five subfamilies, namely, Desmaninæ, Talpinæ, Scalopinæ, Condylurinæ, and Uropsilinæ. The American genera *Scalopus*, *Scapanus*, *Parascalops*, and *Neürotrichus* would fall in the subfamily Scalopinæ, according to this arrangement, while the Condylurinæ would be represented only in America by *Condylura*. Such a system of classification, however, is superficial and unnatural. The anatomical differences, other than dentition, between *Parascalops* or *Neürotrichus* and each of the other genera of American moles are as great as those between *Condylura* and each of the other genera or even greater. In other words, in order to recognize fundamental and consistent subfamilies it would be necessary to raise nearly every genus to the rank of a subfamily. The convenience of such a classification is not apparent, and accordingly subfamilies have been disregarded here.

HISTORY.

No reference appears in literature to a mole inhabiting America until Seba,[2] in 1734, described and illustrated two mammals which he called "*Talpa, Virginianus, niger*" and "*Talpa, rubra, Americana.*" Seba, apparently erroneously, gives "America" as the habitat of each of these animals. His figure and description of *Talpa virginianus niger* clearly indicate that *Talpa europæa* Linnæus was the animal in mind. It is impossible definitely to determine the current species to which his name *Talpa rubra americana* refers; probably he had reference to a specimen of the African genus *Chrysochloris*, but it is possible that he based his account upon a verbal description of some species of the American genus *Geomys*. The essentials of his description of *Talpa rubra americana* refer to the red color, the short, white, scantily haired tail, and the "tridactyle" fore feet. Nevertheless, his account shows that the presence of moles in America probably was suspected at that time. The first definite knowledge of their occurrence seems to have been obtained by Kalm,[3] who, October 28, 1748, saw burrows and runways of moles near Philadelphia, Pa. He captured one of the animals, and remarked upon its strength and ferocity.

Linnæus,[4] in 1758, described two American moles under the names *Sorex aquaticus* and *Sorex cristatus*, basing his accounts largely upon Kalm's work. During the century following Linnæus's descriptions of these two forms, many papers on the habits, anatomy, and taxonomy of American moles appeared—the result of an interest aroused largely by the odd habits, specialized anatomy, and unknown relationships of the group. To discuss here these almost innumerable writings would be impracticable, and only the more important taxonomic revisions and synopses and the first usage of current generic names will be mentioned. All other generic, specific, and subspecific names will be discussed in their proper sequence.

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[1] Thomas, Oldfield, Ann. & Mag. Nat. Hist., series 8, vol. 10, p. 397, October, 1912.

[2] Seba, A., Locupletissimi Rerum Naturalium Thesauri, vol. 1, p. 51, pl. 32, 1734.

[3] Kalm, P., Beschreibung der Reise nach dem nördlichen America, vol. 1, pp. 190-191, 1759.

[4] Linnæus, Systema Naturæ, ed. 10, p. 53, 1758.

The American Talpidæ were confused by early zoologists with the genus *Sorex* and the European genus *Talpa* until the year 1811, when Illiger based the genus *Condylura*[1] upon *Sorex cristatus* Linnæus, and the genus *Scalops*[2] upon *Sorex aquaticus* Linnæus. The generic name *Scalops* had been used previously by Cuvier[3] who, however, gave no description or type species. The name *Scalops* was generally used for the common mole of eastern United States until 1904, when Palmer[4] revived the accepted name, *Scalopus* Geoffroy,[5] which apparently had never been employed since proposed in 1803.

One of the first important treatments of a genus of American moles, other than accounts in books on general natural history, is given by Bachman,[6] who revised the genus *Scalops*, including therein the genera now recognized as *Scalopus*, *Scapanus*, and *Parascalops*. He remarked upon the morphology and distribution of *Scalops aquaticus* and *Scalops townsendii*, and described two new species under the names *Scalops breweri* and *Scalops latimanus*. All of these species are recognized in the present revision.

The genus *Scapanus* was proposed by Pomel,[7] in 1848, to include Bachman's two species, *Scalops townsendii* and *Scalops breweri*. The type of the genus *Scapanus* automatically became *Scalops townsendii* Bachman when True,[8] nearly fifty years after Pomel's publication, described the genus *Parascalops* and designated *Scalops breweri* Bachman as its type.

The genus *Scalops* was restored to the genus *Talpa* by Le Conte[9] in 1854, but his classification was not adopted by zoologists. He divided *Talpa* into three groups: under group 1 he included the European genus known to-day as *Talpa;* under group 2 the modern genera *Scapanus* and *Parascalops;* and under group 3 the genus now known as *Scalopus*. In his revision he described two new forms, one of which, *Talpa reposta*, is a synonym of *Parascalops breweri*

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[1] Illiger, C., Prod. Syst. Mamm. et Avium, p. 125, 1811.

[2] Illiger, loc. cit., p. 126, 1811.

[3] Cuvier, G., Leçons d'Anat. Comp., vol. 1, tab. 1, 1800.

[4] Palmer, T. S., Index Generum Mamm., N. Am. Fauna No. 23, p. 620, Jan. 23 1904.

[5] Geoffroy Saint Hilaire, É., Cat. Mamm. Mus. Nat. Hist. Nat., p. 77, 1803.

[6] Bachman, J., Boston Journ. Nat. Hist., vol. 4, pp. 26–35, January, 1842.

[7] Pomel, A., Archiv. Sci. Phys. et Nat., vol. 9, p. 247, November, 1848.

[8] True, F. W., Proc. U. S. Nat. Mus., vol. 17, p. 242, April 26, 1894.

[9] Le Conte, Joseph, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, pp. 326–327, 1854.

(Bachman); the other, *Talpa tæniata*, is synonymous with *Scapanus townsendii* (Bachman).

The same year that Le Conte's revision appeared, a mole related to the Japanese genus *Urotrichus* was collected by George Gibbs in the Cascade Mountains of western Washington. This specimen later became the type of *Urotrichus gibbsii* Baird,[1] a species which subsequently became the type of the genus *Neürotrichus* Günther.[2]

In 1875 Gill[3] presented a synopsis of the Insectivora, in which he classified families, subfamilies, and genera, dividing the family Talpidæ into two subfamilies, Talpinæ and Myogalinæ. The Talpinæ were further subdivided into three sections, Talpæ, Condyluræ, and Scalopes; the Myogalinæ into the sections Mygalæ and Urotrichi. The American genus *Condylura* represented the section Condyluræ; *Scalops* and *Scapanus* (including also the form now known as *Parascalops*) represented the section Scalopes; *Urotrichus* (including also the present *Neürotrichus*) and the shrewlike *Uropsilus* formed the section Urotrichi.

Two years after Gill's synopsis was published there appeared a preliminary revision of the American Insectivora by Coues,[4] in which he listed six species of moles belonging to four genera.

Dobson,[5] in an extensive revision of the Insectivora published in 1883, gave detailed accounts of the taxonomic characters and anatomy of moles, recognizing five American species which he placed in four genera.

However, it was not until True's monumental revision[6] of the American moles, in 1896, that the distribution and taxonomic relationships of the group in America began to be understood. True recognized eleven forms, distributed among eight species of five genera, and described one new species, *Scapanus orarius*.[7]

LIST OF GENERIC NAMES THAT HAVE BEEN USED FOR AMERICAN MOLES.

Astromycter Harris, Amer. Journ. Sci. and Arts, vol. 9, p. 400, June, 1825 (from Machias, Me., "Star" [newspaper]). A synonym of *Condylura* Illiger. Based on an abnormally colored specimen of *Condylura cristata* with the tail in the enlarged winter condition.

Astromyctes Gray, List Spec. Mamm. Brit. Mus., p. 76, 1843. Misprint for *Astromycter* Harris (=*Condylura* Illiger).

Astromydes Blyth, Cat. Mamm. Asiat. Soc. Mus., p. 87, 1863. Misprint or emendation for *Astromycter* Harris (=*Condylura* Illiger).

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[1] Baird, S. F., Reports Explor. & Surv. Pacific Railroad, vol. 8, part 1, p. 76, 1857.

[2] Günther, A., Proc. Zool. Soc. London, 1880, p. 441, October, 1880.

[3] Gill, T., Bul. U. S. Geol. & Geog. Surv. Terr., no. 2, series 2, pp. 91-120, 1875.

[4] Coues, E., Bul. U. S. Geol. & Geog. Surv. Terr., vol. 3, no. 3, pp. 631-653, May 15, 1877.

[5] Dobson, G. E., Monograph of the Insectivora, systematic and anatomical. Part 2, including the families Potamogalidæ, Chrysochloridæ, and Talpidæ, 1883.

[6] True, F. W., Proc. U. S. Nat. Mus., vol. 19, pp. 1-112, 1896.

[7] True, F. W., loc. cit., p. 52.

Condylura Illiger, Prod. Syst. Mamm. et Avium, p. 125, 1811. Earliest available name for the genus of which the type is *Sorex cristatus* Linnæus. "We owe the name *Condylura* to the faulty figure of the animal given by De La Faille, in which the tail is represented as constricted at intervals, the whole resembling a string of beads. From this Illiger was led to include in his diagnosis the expression 'cauda mediocris nodosa,' and to bestow an inappropriate name."[1] Illiger includes two species under the genus: *Sorex cristatus* Linnæus and *Talpa longicaudata* Erxleben.

Condylurus Blainville, Ann. Français et Étrangères d'Anat. et de Physiol., vol. 2, p. 219, 1838. Emendation for *Condylura*, used subgenerically ad *Talpa cristata*.

Condylus Van Hyning, Science, n. s., vol. 38, p. 243, August 15, 1913. Misprint for *Condylura*.

Condytura Todd, Cyclopædia Anat. and Physiol., vol. 2, p. 994, 1839. Used erroneously, but consistently, for *Condylura* Illiger.

Neourotrichus Rye, Zool. Record, vol. 17, index, p. 8, 1881. Emendation for *Neürotrichus* Günther.

Neürotrichus Günther, Proc. Zool. Soc. London, 1880, p. 441, October, 1880. Earliest name for the genus of which *Urotrichus gibbsii* Baird is the type. Sometimes used without the diæresis (*Neurotrichus* Forbes, Zool. Record, vol. 17, Mammalia, p. 14, 1881).

Nëurotrichus Günther, Proc. Zool. Soc. London, 1880, plate 42, October, 1880. Misprint for *Neürotrichus*.

Parascalops True, Proc. U. S. Nat. Mus., vol. 27, p. 242, April 26, 1894. The first available name for the genus of which *Scalops breweri* Bachman is the type.

Perascalops Beddard, Cambridge Nat. Hist., vol. 10, Mammalia, p. 518, 1902. Misprint for *Parascalops*.

Rhinaster Wagler, Nat. Syst. Amphib., p. 14, 1830. Name proposed by Wagler to replace *Condylura* Illiger which he considered misleading.[2] Under this he mentions two species: *Sorex cristatus* Linnæus and *Condylura prasinata* Harris.

Scalops Cuvier, Leçons d'Anatomie Comparée, vol. 1, Premier Tableau Général des Classes des Animaux, 1800. Nomen nudum. The generic name *Scalops* later was based upon *Sorex aquaticus* Linnæus by Illiger (Prod. Syst. Mamm. et Avium, p. 126, 1811), but is preoccupied by *Scalopus* Geoffroy.

Scalopus Geoffroy, Cat. Mamm. Mus. Nat. Hist. Nat., p. 77, 1803. Earliest available name for the genus of which *Sorex aquaticus* Linnæus in the type.[3]

Scalpos Brooks, Rept. W. Va. State Board Agric., Quarter ending December 30, 1910, p. 28, 1911. Misprint for *Scalops*.

Scapanus Pomel, Archives Sci. Physiques et Nat., vol. 9, p. 247, November, 1848. Tenable name for the genus of which *Scalops townsendii* Bachman is the type.[4] Pomel's description [5] is faulty in that it states that the nostrils are lateral, a condition which is not found in *Scapanus townsendii*.

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[1] True, F. W., Proc. U. S. Nat. Mus., vol. 19, p. 78, 1896.

[2] "Wie bekannt, ist der Schwanz dieses Thieres vollkommen eben." (Wagler, loc. cit.)

[3] Type fixed by Palmer, T. S. (Index Gen. Mamm., N. Am. Fauna No. 23, p. 621, 1904). The original generic description reads: "Caract. nat. Deux incisives à la mâchoire supérieure, quatre à l'inférieure, les intermédiaires fort petites; un boutoir, une queue assez longue; pieds pentadactyles, doigts des pâtes antérieures réunis jusqu'aux ongles seulement; ces ongles assez longs, plats, et dirigés un peu en arrière; corps couvert de poils." (Geoffroy, 1803, loc. cit.)

[4] Type fixed by Elliot, D. G. (Field Columb. Mus., publ. 45, zool. series, vol. 2, p. 391, 1901).

[5] "2e type, LEPTORHINIENS, trompe grêle aiguë, narines ouvertes près de l'extrémité.

" Genres *Hyporyssus?*, *Scalops*, *Scapanus*.

" NOTA.—Ce troisième genre diffère des scalops par la position latérale et non supérieure de l'ouverture des narines, et par la formule dentaire comprenant une intermédiaire supérieure et trois inférieures de plus. Les espèces sont: Scapanus Towsendii (sic) et Breweri (Scal. Towsendii (sic) et Breweri Bachm.)." (Pomel, A., 1848, loc. cit., p. 247).

Scapasius Beddard, Cambridge Nat. Hist., vol. 10, Mammalia, p. 518, 1902. Misprint for *Scapanus*.

Scaphanus Herrick, Mamm. Minnesota, Geol. and Nat. Hist. Surv. Minnesota, Bul. 7, p. 55, 1892. Misprint or emendation for *Scapanus*.

Sorex Linnæus, Syst. Nat., ed. 10, vol. 1, p. 53, 1758. The American moles *Condylura cristata* and *Scalopus aquaticus* were placed in the genus *Sorex* by Linnæus. Shaw (Gen. Zool., Mamm., vol. 1, p. 531, 1800) described *Sorex radiatus* (=*Condylura cristata*) from a description and faulty figure by De La Faille.

Talpa Linnæus, Syst. Nat., ed. 10, vol. 1, p. 52, 1758. Type species: *Talpa europæa* Linnæus. A Palæarctic genus with which some or all American moles were considered congeneric by certain early writers. Last used for American Talpidæ by Le Conte (Proc. Acad. Nat. Sci. Philadelphia, vol. 6, p. 326, 1854), who referred to it the genera now known as *Scalopus*, *Scapanus*, and *Parascalops*.

Talpasorex Schinz, Cuvier's Thierreich, vol. 1, p. 191, 1821. Substitution for *Condylura* Illiger.

Talpasorex Lesson, Manuel de Mammalogie, p. 124, 1827. Synonym of *Scalopus* Geoffroy. Based upon *Scalops pennyslvanica* Harlan (=*Sorex aquaticus* Linnæus), in the original description of which the dental formula was erroneously stated. Nec *Talpasorex* Schinz, by which it is preoccupied.

Urotrichus Temminck, Van-der Hœven's Tijdschr. Nat. Geschied. Physiol., vol. 5, p. 286, 1838–1839. A Japanese genus with which *Neürotrichus* was included until 1880.

Keys to the Genera of Moles.

[Based on external characters.]

a.^{1} Length of tail vertebræ less than one-fourth the total length; width of palm equaling or exceeding length of palm.
  b.^{1} Tail naked or but scantily haired; nostrils superior.
    c^1. Tail somewhat slender, essentially naked; fore toes webbed; geographic range east of Rocky Mountains.................................*Scalopus* (p. 27).
    c^2. Tail somewhat fleshy, scantily haired; fore toes not webbed; geographic range west of Rocky Mountains ....*Scapanus* (p. 54).
  b.^{2} Tail densely covered with hair; nostrils lateral...........*Parascalops* (p. 77).
a.^{2} Length of tail vertebræ more than one-fourth the total length; width of palm less than length of palm.
  b.^{1} Anterior end of snout surrounded by fringe of processes; nostrils circular to oval, anterior; geographic range east of Rocky Mountains... *Condylura* (p. 82).
  b^2. Anterior end of snout not surrounded by fringe of processes; nostrils crescentic, lateral; geographic range west of Rocky Mountains....*Neürotrichus* (p. 92).

[Based on cranial and dental characters.]

a^1. Audital bullæ complete; interior basal projection of upper molars narrow, simple.
  b^1. Mastoids relatively heavy; interparietal small; no functional lower canine; lower incisors two; geographic range east of Rocky Mountains.*Scalopus* (p. 27).
  b^2. Mastoids relatively weak; interparietal large; lower canine present; lower incisors three; geographic range west of Rocky Mountains...*Scapanus* (p. 54).
a^2. Audital bullæ incomplete; interior basal projection of upper molars relatively broad, lobed.
  b^1. Interior basal projection of first and second upper molars trilobed; premolars, $\frac{4}{4}$.
    c^1. Braincase relatively broad and flat; anterior nares directed forward; first upper incisors broad, directed downward, with an exterior basal accessory cusp..*Parascalops* (p. 77).

c^3. Braincase relatively narrow and high; anterior nares directed obliquely upward; first upper incisors spatulate, directed somewhat forward, without a basal accessory cusp .... *Condylura* (p. 82).

b^3. Interior basal projection of first and second upper molars bilobed; premolars, $\frac{4}{4}$ .... *Neürotrichus* (p. 92).

List of American Genera, Species, and Subspecies, with Type Localities.

Scalopus aquaticus aquaticus (Linnæus)	Philadelphia, Pa. (p. 32).
aquaticus howelli Jackson	Autaugaville, Ala. (p. 36).
aquaticus australis (Chapman)	Gainesville, Fla. (p. 38).
aquaticus anastasæ (Bangs)	Point Romo, Anastasia Island, Fla. (p. 39).
aquaticus parvus (Rhoads)	Tarpon Springs, Fla. (p. 41).
aquaticus machrinus (Rafinesque)	Lexington, Ky. (p. 42).
aquaticus machrinoides Jackson	Manhattan, Kans. (p. 45).
aquaticus pulcher Jackson	Delight, Ark. (p. 46).
aquaticus caryi Jackson	Neligh, Nebr. (p. 48).
aquaticus intermedius (Elliot)	Alva, Okla. (p. 49).
aquaticus texanus (Allen)	Rockport, Tex. (p. 50).
æreus (Bangs)	Stilwell, Okla. (p. 52).
inflatus Jackson	45 miles from Brownsville, Tex., in Tamaulipas, Mexico (p. 53).
Scapanus townsendii (Bachman)	Vicinity of Vancouver, Wash. (p. 58).
orarius orarius True	Shoalwater Bay, Wash. (p. 61).
orarius schefferi nobis	Walla Walla, Wash. (p. 63).
latimanus latimanus (Bachman)	Santa Clara, Cal. (p. 64).
latimanus occultus Grinnell & Swarth	Santa Ana Canyon, Cal. (p. 68).
latimanus grinnelli Jackson	Independence, Cal. (p. 69).
latimanus sericatus Jackson	Yosemite, Cal. (p. 71).
latimanus minusculus Bangs	Fyffe, Cal. (p. 72).
latimanus dilatus True	Fort Klamath, Oreg. (p. 72).
latimanus alpinus Merriam	Crater Lake, Oreg. (p. 75).
anthonyi Allen	San Pedro Martir Mountains, Lower California. (p. 75).
Parascalops breweri (Bachman)	Marthas Vineyard, Mass. (p. 79).
Condylura cristata (Linnæus)	Eastern Pennsylvania (p. 86).
Neürotrichus gibbsii gibbsii (Baird)	White River Pass, Wash. (p. 94).
gibbsii hyacinthinus Bangs	Nicasio, Cal. (p. 97).

Genus SCALOPUS Geoffroy.

Scalops Cuvier, Leçons d'Anat. Comp., tome 1, tabl. 1, 1800. (Nomen nudum.)

Scalopus Geoffroy, Cat. Mamm. Mus. Nat. Hist. Nat., p. 77, 1803.

Scalops Illiger, Prod. Syst. Mamm. et Avium, p. 126, 1811.

Talpasorex Lesson, Manuel de Mamm., p. 124, 1827. Based upon *Scalops pennsylvanica* Harlan. Nec *Talpasorex* Schinz.

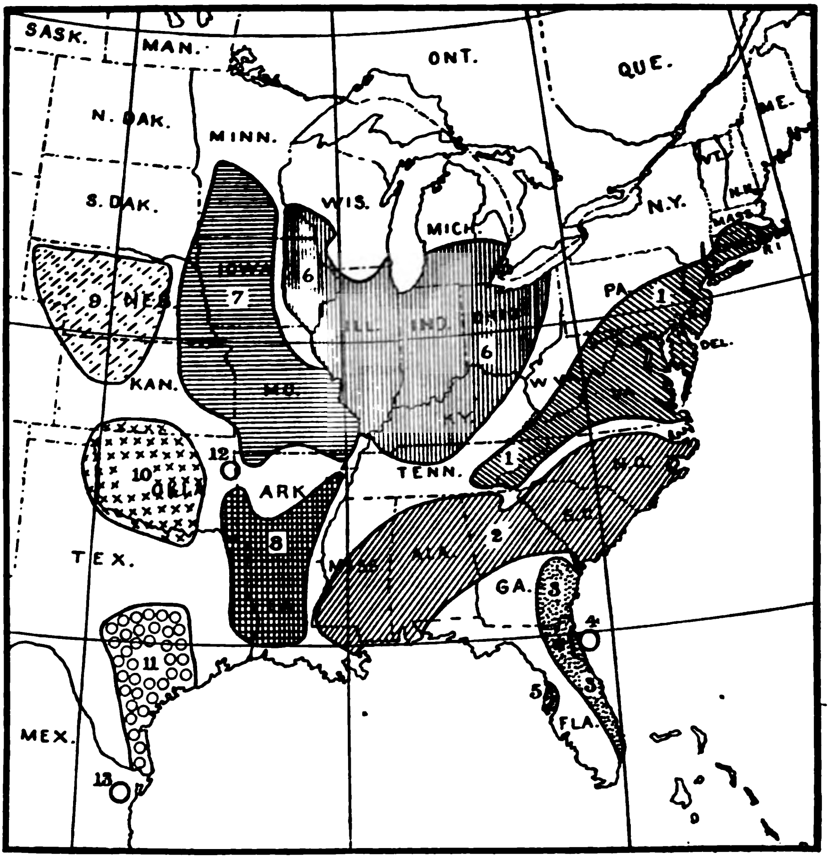
Scalpos Brooks, Rept. W. Va. State Board Agric. for Quarter ending December 30 1910, p. 28, 1911.

Type species.—*Sorex aquaticus* Linnæus.

Geographic range.—Eastern and central Massachusetts, southeastern New York, southern Pennsylvania, extreme southern Ontario (Point Pelee), southern Michigan, northern Illinois, western

Wisconsin, central Minnesota, extreme southeastern South Dakota, northern Nebraska, extreme northeastern Colorado, south and east to northeastern Tamaulipas, Mexico (45 miles from Brownsville, Texas), to the Gulf of Mexico, and in Florida to Tampa Bay and Lemon City. (See fig. 2).

External characters.—Body robust, depressed; tail short, round, indistinctly annulated, very scantily haired (in appearance, essentially naked) (fig. 3). Head conoidal, depressed. Nose elongated into a distinct snout, apical portion naked to line of anterior edge of nasals; nostrils superior, crescentic, with concavities turned in laterally (fig. 4). Eyes minute, concealed in fur. Auricular orifice small. Legs short and stout. Feet large, fleshy, scantily haired above, naked below, without tubercles. Fore feet handlike, the palms



B2008–103

FIG. 2.—Geographic range of the species and subspecies of *Scalopus*.

1. *S. aquaticus aquaticus.*
2. *S. a. howelli.*
3. *S. a. australis.*
4. *S. a. anastasæ.*
5. *S. a. parvus.*
6. *S. a. machrinus.*
7. *S. a. machrinoides.*
8. *S. a. pulcher.*
9. *S. a. caryi.*
10. *S. a. intermedius.*
11. *S. a. texanus.*
12. *S. æreus.*
13. *S. inflatus.*

broader than long (fig. 5). Fore toes and hind toes webbed. Claws of fore feet broad, flat, and heavy; those of hind feet relatively short and weak (fig. 6). Fur dense, soft, silky, the hairs nearly equal in length, producing a velvetlike pelage. Mammæ 6: latero-pectoral, 1–1; latero-abdominal, 1–1; inguinal, 1–1.

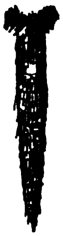

B2009-103

FIG. 3.—Tail of *Scalopus aquaticus aquaticus* (X 1⅓). No. 203190, U. S. Nat. Mus., Biological Survey collection; from Woodside, Montgomery County, Md.

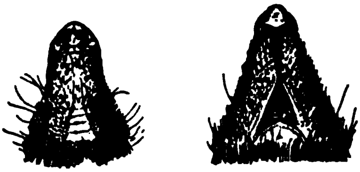

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FIG. 4.—Snout of *S. a. aquaticus* (X 1⅓). Individual referred to in fig. 2.

Skeletal characters.—Clavicle short and heavy, about two-thirds as broad as long, penetrated antero-posteriorly through the center by a small circular foramen; humerus heavy, about three-fourths as broad as long. Pelvis narrow, bones of the opposite sides adjunct under acetabula; two osseous bridges connect sacral vertebræ with ischium and produce four large foramina or openings, one in each of the angles formed by median lines of acetabula and sacral vertebræ. Superior surface of last sacral vertebra with a very small, low, laterally flattened, longitudinal process. Os falciforme long, reaching to proximal end of terminal phalange of first digit, wider and rather sharply incurved at base, narrower and gradually tapering distally.

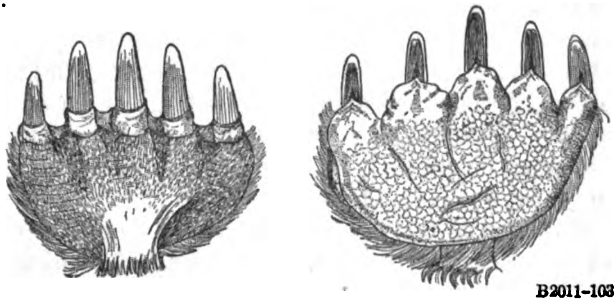
B2011-103

FIG. 5.—Fore foot of *S. a. aquaticus* (X 1⅓). Individual referred to in fig. 2.

Skull conoidal, flat, with relatively broad braincase, and considerably constricted interorbitally. Mastoids relatively heavy and prominent. Interparietal short and narrow, somewhat irregular in outline, but usually narrower anteriorly. Frontal region flat, not much sloping; frontal sinuses swollen. Rostrum relatively short; anterior ends of premaxillæ much thickened and extending beyond nasals, forming an acute notch anterior to nasals. Anterior nares opening forward. Zygomata moderately long and heavy, not much curved, descending slightly and slanting inward anteriorly, the posterior end well back on squamosal. Foramen magnum oval, of moderate size. Infraorbital

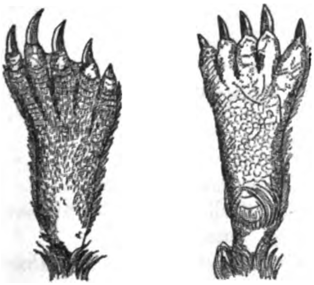
B2012-103

FIG. 6.—Hind foot of *S. a. aquaticus* (X 1⅓). Individual referred to in fig. 2.

foramen relatively small, the plate forming its outer wall moderately broad (slightly narrower than diameter of foramen). Audital bullæ complete, depressed (relatively higher than in *Scapanus*); auditory meatus short, scarcely developed. External pterygoid region much inflated posteriorly, slightly inflated anteriorly. Mesopterygoid space broad, the sides gently concave. Palate moderately elongate, terminating at a distance posterior to last molar about equal to diameter of that tooth; posterior border of palate truncate, frequently with a median notch or spine. Anterior palatine foramina small, oval to elliptical; first (anterior) pair of posterior palatine foramina small (smaller than anterior palatine foramina), round to oval; second (posterior) pair minute. Horizontal ramus of mandible heavy, curved upward both at posterior and anterior ends; coronoid process moderately elongate, triangular, somewhat acute, directed slightly posteriorly; angle of mandible relatively short, broad (broader than coronoid), and truncate; inferior mandibular notch moderate, subcircular, relatively narrow and deep.

Dental characters.—First upper incisor long and broad, convex in front, flat posteriorly; second and third upper incisors lateral, simple, conical, minute. Upper canine about two-thirds as large as first incisor, simple. Upper premolars indistinctly cuspidate, the second about twice the size of the first and about equal in size to canine (but broader), the third about half as large again as the second. Upper molars W-shaped in transverse section, with an antero-internal V-shaped cusplike shelf (not lobed); first and second molars subequal, the third much smaller.

First lower incisor small, elongate, conical; second lower incisor about twice the size of the first, elongate, caninelike, with an infero-internal longitudinal groove; no persistent lower canine. Premolars successively increasing in size posteriorly, somewhat simple, with a slight tendency toward the development of a cingulum posteriorly. Lower molars M-shaped in transverse section, the antero-internal cusp bilobed; molars successively decreasing in size posteriorly. Functional dentition: i. $\frac{3}{2}$; c. $\frac{1}{0}$; pm. $\frac{3}{3}$; m. $\frac{3}{3}$; total 36.[1]

Keys to Species and Subspecies of Scalopus.

I. KEY TO ADULT MALES.

a.[1] Geographic range east of Mississippi River.
  b.[1] Total length more than 153 mm.; greatest length of skull more than 33 mm.; breadth of skull across mastoids usually more than 17 mm.
    c.[1] Total length less than 190 mm.; length of hind foot less than 21.5 mm.; greatest length of skull less than 37 mm.; breadth of skull across mastoids less than 19 mm .... *Scalopus aquaticus aquaticus* (p. 32).

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[1] The actual dentition of *Scalopus* is: i. $\frac{3}{3}$; c. $\frac{1}{1}$; pm. $\frac{3}{3}$; m. $\frac{3}{3}$; total, 40. The third lower incisor and the lower canine are nonpersistent and disappear before the animal is mature.

c.^{2} Total length more than 190 mm.; length of hind foot more than 21.5 mm.; greatest length of skull more than 37 mm.; breadth of skull across mastoids more than 19 mm .... *Scalopus aquaticus machrinus* (p. 42).

b.^{2} Total length less than 153 mm.; greatest length of skull less than 33 mm.; breadth of skull across mastoids usually less than 17 mm.

c.^{1} Length of hind foot usually less than 17 mm.; greatest length of skull 31.2 mm. or less; breadth of skull across mastoids less than 16 mm., *Scalopus aquaticus parvus* (p. 41).

c.^{2} Length of hind foot usually more than 17 mm.; greatest length of skull more than 31.2 mm.; breadth of skull across mastoids more than 16 mm.

d.^{1} Color golden sepia; face, chin, and wrists bright zinc orange; geographic range Anastasia Island, Fla.......... *Scalopus aquaticus anastasæ* (p. 39).

d.^{2} Color not golden sepia; face, chin, and wrists not bright zinc orange.

e.^{1} Color paler; greatest length of skull usually more than 32 mm.; geographic range North and South Carolina, northern and western Georgia, west to mouth of Mississippi River.... *Scalopus aquaticus howelli* (p. 36).

e.^{2} Color darker; greatest length of skull usually less than 32 mm.; geographic range southeastern Georgia and eastern Florida, *Scalopus aquaticus australis* (p. 38).

a.^{2} Geographic range west of Mississippi River.

b.^{1} Breadth of skull across mastoids 19.3 mm. or more.

c.^{1} Breadth of skull across mastoids more than 20 mm.; palatilar length more than 16 mm.............................. *Scalopus aquaticus machrinus* (p. 42).

c.^{2} Breadth of skull across mastoids less than 20 mm.; palatilar length less than 16 mm............................ *Scalopus aquaticus machrinoides* (p. 45).

b.^{2} Breadth of skull across mastoids less than 19.3 mm.

c.^{1} Greatest length of skull more than 33 mm.; interorbital constriction more than 7.3 mm.

d.^{1} Color coppery snuff brown......................... *Scalopus æreus* (p. 52).

d.^{2} Color not coppery snuff brown.

e.^{1} Color dark; geographic range east of 95th meridian, *Scalopus aquaticus pulcher* (p. 46).

e.^{2} Color pale; geographic range west of 95th meridian.

f.^{1} Nose and ankles tinged with ochraceous, *Scalopus aquaticus intermedius* (p. 49).

f.^{2} Nose and ankles not tinged with ochraceous, but usually with ivory yellow........................... *Scalopus aquaticus caryi* (p. 48).

c.^{2} Greatest length of skull less than 33 mm.; interorbital constriction less than 7.3 mm.

d.^{1} Prelachrymal region much inflated; rostrum broad and truncate; geographic range Tamaulipas, Mexico.............. *Scalopus inflatus* (p. 53).

d.^{2} Prelachrymal region not much inflated; rostrum not broad and truncate; geographic range Texas................ *Scalopus aquaticus texanus* (p. 50).

II. KEY TO ADULT FEMALES.

a.^{1} Geographic range east of Mississippi River.

b.^{1} Total length usually more than 148 mm.; greatest length of skull more than 32 mm.; breadth of skull across mastoids usually more than 16.5 mm.

c.^{1} Total length less than 173 mm.; length of hind foot less than 21 mm.; greatest length of skull less than 35.2 mm.; breadth of skull across mastoids less than 18.7 mm.......................... *Scalopus aquaticus aquaticus* (p. 32).

c.^{2} Total length more than 173 mm.; length of hind foot more than 21 mm.; greatest length of skull more than 35.2 mm.; breadth of skull across mastoids more than 18.7 mm.................. *Scalopus aquaticus machrinus* (p. 42).

b.^{2} Total length usually less than 148 mm.; greatest length of skull 32 mm. or less; breadth of skull across mastoids usually less than 16.5 mm.

c.^{1} Total length less than 130 mm.; length of tail less than 18 mm.; greatest length of skull 29.3 mm. or less...............*Scalopus aquaticus parvus* (p. 41).

c.^{2} Total length more than 130 mm.; length of tail more than 18 mm.; greatest length of skull more than 29.3 mm.

d.^{1} Color golden sepia; face, chin, and wrists bright zinc orange; geographic range Anastasia Island, Fla..........*Scalopus aquaticus anastasæ* (p. 39).

d.^{2} Color not golden sepia; face, chin, and wrists not bright zinc orange.

e.^{1} Color paler; greatest length of skull usually more than 31 mm.; geographic range North and South Carolina, northern and western Georgia, west to mouth of Mississippi River..........*Scalopus aquaticus howelli* (p. 36).

e.^{2} Color darker; greatest length of skull usually less than 31 mm.; geographic range southeastern Georgia and eastern Florida,
Scalopus aquaticus australis (p. 38).

a.^{2} Geographic range west of Mississippi River.

b.^{1} Total length more than 160 mm.; breadth of skull across mastoids more than 18.4 mm.

c.^{1} Breadth of skull across mastoids more than 19 mm.; palatilar length more than 15.8 mm............................*Scalopus aquaticus machrinus* (p. 42).

c.^{2} Breadth of skull across mastoids less than 19 mm.; palatilar length less than 15.8 mm.........................*Scalopus aquaticus machrinoides* (p. 45).

b.^{2} Total length less than 160 mm.; breadth of skull across mastoids less than 18.4 mm.

c.^{1} Greatest length of skull more than 32 mm.; interorbital constriction more than 7.2 mm.

d.^{1} Color coppery snuff brown.........................*Scalopus æreus* (p. 52).

d.^{2} Color not coppery snuff brown.

e.^{1} Color dark; geographic range east of 95th meridian,
Scalopus aquaticus pulcher (p. 46).

e.^{2} Color pale; geographic range west of 95th meridian.

f.^{1} Nose and ankles tinged with ochraceous,
Scalopus aquaticus intermedius (p. 49).

f.^{2} Nose and ankles not tinged with ochraceous, but usually with ivory yellow...........................*Scalopus aquaticus caryi* (p. 48).

c.^{2} Greatest length of skull less than 32 mm.; interorbital constriction less than 7.2 mm.

d.^{1} Prelachrymal region much inflated; rostrum broad and truncate; geographic range Tamaulipas, Mexico.............*Scalopus inflatus* (p. 53).

d.^{2} Prelachrymal region not much inflated; rostrum not broad and truncate; geographic range Texas...............*Scalopus aquaticus texanus* (p. 50).

Descriptions of Species and Subspecies of Scalopus.

SCALOPUS AQUATICUS AQUATICUS (Linnæus).

EASTERN MOLE.

(Pl. I, figs. 1, 2; Pl. II, fig. 1; Pl. III, figs. 1, 1a; Pl. VI, fig. 3.)

Sorex aquaticus Linnæus, Syst. Nat., ed. 10, p. 53, 1758.

Talpa europæa flavescens Erxleben, Syst. Reg. Anim., p. 118, 1777. Based on "yellow mole" of Pennant; type locality, New York(?).

Talpa Flava Zimmermann, Specimen Zool. Geog., p. 496, 1777. Based on "yellow mole" of Pennant; type locality, New York(?).

Talpa fusca Zimmermann, Specimen Zool. Geog., p. 497, 1777. Based on "Brown mole" of Pennant; type locality, New York(?).

[*Talpa*] [*europæa*] *flava* Gmelin, Linn. Syst. Nat., ed 13, p. 110, 1788.

Scalopus virginianus Geoffroy, Cat. Mamm. Mus. Nat. Hist. Nat., p. 78, 1803. Type locality, Virginia(?).

Talpa cupreata Rafinesque, Précis des découv. et travaux somiologiques, p. 14, 1814. Type locality, "Atlantic States" (see Atl. Journ. 1832, p. 61).

Scalops canadensis Desmarest, Mammalogie, 1^re^ partie, p. 155, 1820. New name for *Sorex aquaticus* Linnæus.

Scalops pennsylvanica Harlan, Fauna Amer., p. 33, 1825. Type locality unknown, probably Pennsylvania.

Talpasorex pensylvanica Lesson, Manuel de Mamm., p. 124, 1827.

Sc[*alops*] *aquaticus* Fischer, Synop. Mamm., p. 249, 1829.

Talpa virginiana Blainville (nec *Talpa virginiana* Brisson), Annales Franç. et Étrang. d'Anat et de Physiol., tome 2, p. 219, 1838.

Talpa sorex pensylvanicus Blainville, Annales Franç. et Étrang. d'Anat. et de Physiol., tome 2, p. 219, 1838. (In synonymy.)

Talpa (*Scalops*) *Virginiana* Blainville (nec *Talpa virginiana* Brisson), Ostéographie, Atlas 1, table des planches, p. 4; Insectivores, pl. 5 (skull), pl. 9 (teeth), 1839–1864.

T[*alpa*] *aquatica* Le Conte, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 327, 1854.

Scalops aquaticus aquaticus True, Proc. U. S. Nat. Mus., vol. 7, 1884, p. 606, 1885.

Scalopus aquaticus Oberholser, Mammals and Summer Birds of Western North Carolina (publ. by Biltmore Forest School, Biltmore, N. C.), p. 3, June 30, 1905.

Scalopus acquaticus (sic) Hahn, Proc. U. S. Nat. Mus., vol. 32, p. 464, 1907.

Scalpos (sic) *aquaticus* Brooks, Rept. W. Va. Board Agric., 1910, p. 28, 1911.

Scalopus aquaticus aquaticus Miller, U. S. Nat. Mus., Bul. 79, p. 7, December 31, 1912.

Type locality.—Philadelphia, Pennsylvania.

Geographic range.—Eastern United States from eastern and southern Massachusetts, southeastern New York, and southeastern Pennsylvania, south through Virginia, and in the Appalachian Mountains south through western North Carolina and eastern Tennessee.

General characters.—Size medium; color dark; skull high, heavy, and angular; rostrum truncate; dentition moderate.

Color.—*Fresh winter pelage:* Back fuscous, fuscous-black, or blackish brown, becoming paler (drab-gray) on nose and ankles; fur at base of hairs dark neutral gray; underparts slightly paler than back, usually showing more neutral gray of base of hairs and frequently tinged ventrally with mummy brown or fuscous. *Summer pelage:* Slightly paler than in winter, usually more brownish; back sepia, fuscous, or fuscous-black; underparts paler than back, more grayish and usually tinged on chest with mummy brown or sepia. *Young:* More grayish than adults and seldom, if ever, tinged ventrally with brown.

Skull.—Medium in size, angular, much constricted interorbitally and usually somewhat depressed postorbitally, slightly swollen supraorbitally; mastoids moderately heavy; interparietal narrow;

coronoid process and angle of mandible broad and heavy, the former usually with a small mammiform process on posterior border; teeth medium.

Measurements.—Average of 2 adult males from type locality: Total length, 182.5 (180–185); tail vertebræ, 29.5 (28–31); hind foot, 21 (21–21). Average of 2 adult females from type locality: 154.5 (154–155); 23 (23–23); 19.5 (19–20). Average of 15 adult males from Washington, D. C.: 163.4 (154–175); 26.5 (22–29); 19.8 (18–21). Average of 8 adult females from Washington, D. C.: 152.6 (146–168); 26 (21–28); 19 (18–20). Average of 6 adult males from Wareham, Mass.: 159.8 (154–167); 26.3 (21.5–30); 19.9 (19.5–21). *Skull:* Average of 3 skulls of adult males from type locality: Greatest length, 35.3 (34.6–35.7); palatilar length, 14.8 (14.7–15); mastoidal breadth, 18 (17.8–18.2); interorbital breadth, 7.4 (7.3–7.5); maxillary tooth row, 10.9 (10.9–11); mandibular molar-premolar row, 10.7 (10.6–10.8). Average of 21 skulls of adult males from Washington, D. C., and vicinity: Greatest length, 34.3 (33.2–35.6); palatilar length, 14.7 (14.3–15.2); mastoidal breadth, 17.7 (17–18.3); interorbital breadth, 7.4 (7.2–7.8); maxillary tooth row, 10.8 (10.4–11.3); mandibular molar-premolar row, 10.4 (10.1–10.8). Average of 15 skulls of adult females from Washington, D. C., and vicinity: Greatest length, 32.9 (32.3–34.2); palatilar length, 13.9 (13.5–14.7); mastoidal breadth, 17.1 (16.3–17.5); interorbital breadth, 7.4 (7–7.6); maxillary tooth row, 10.4 (10.1–10.8); mandibular molar-premolar row, 10.2 (9.8–10.4). Average of 5 skulls of adult males from Wareham, Mass.: Greatest length, 34.3 (33.8–34.8); palatilar length, 14.8 (14.5–15); mastoidal breadth, 18.1 (17.8–18.4); interorbital breadth, 7.7 (7.6–7.7); maxillary tooth row, 11 (10.8–11.2); mandibular molar-premolar row, 10.7 (10.6–10.8). Average of 2 skulls of adult males from Dismal Swamp (Wallaceton), Va.: Greatest length, 35.2 (35.1–35.2); palatilar length, 14.8 (14.6–15); mastoidal breadth, 18.1 (18–18.2); interorbital breadth, 7.5 (7.4–7.6); maxillary tooth row, 11.1 (11–11.2); mandibular molar-premolar row, 10.7 (10.6–10.7). Skull of adult male from Roan Mountain, N. C.: Greatest length, 36.1; palatilar length, 15.5; mastoidal breadth, 18.4; interorbital breadth, 7.8; maxillary tooth row, 11.3; mandibular molar-premolar row, 11.

Remarks.—The first specific description of the common mole of eastern United States is that under *Sorex aquaticus* Linnæus;[1] Linnæus places in its synonymy "*Talpa, Virginianus, niger*" of Seba; but the description and figure[2] given by Seba seem to characterize the European rather than the American mole; the Linnæan description, however, clearly refers to the common mole of eastern America; as an authority for the habitat of the species, Linnæus cites Kalm, who saw mole runways along the Schuylkill River near Philadelphia.

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[1] Linnæus, Syst. Nat., ed. 10, p. 53, 1758.

[2] Seba, A., Thesaurus, vol. 1, p. 51, pl. 32, 1734. Seba's description of *Talpa virginianus niger* became the basis for Shaw's diagnosis of *Talpa purpurascens* (Shaw, G., Gen. Zool., Mamm., vol. 1, p. 521, 1800), which is therefore a synonym of *Talpa europæa* Linnæus.

In 1771 Pennant[1] described two abnormally colored or faded specimens of this species under the names of "Yellow Mole" and "Brown Mole"; the yellow mole became *Talpa europæa flavescens* at the hands of Erxleben[2] in 1777, and the same year Zimmermann[3] named the yellow species *Talpa flava* and the brown one *Talpa fusca.* Geoffroy[4] described *Scalopus virginianus* in 1803, placing in synonymy under it *Talpa virginianus niger* Seba and *Sorex aquaticus* Linnæus.

The description given by Rafinesque[5] of *Talpa cupreata* is unsatisfactory, but seems to apply to the subspecies *S. a. aquaticus.* The synonymy of this form was still further encumbered when Desmarest[6] proposed the name *Scalops canadensis* in 1820, apparently basing the name upon "Le Scalope du Canada" of Cuvier and others. The last specific name added to the synonymy of this form is *Scalops pennsylvanica* Harlan;[7] Harlan believed the structure of the molars in the specimen he described to be different from that of *S. aquaticus,* but his description applies very accurately to *S. aquaticus* except as to the number of teeth, which he states to be forty; elsewhere, however, he writes that "this species corresponds in the number and arrangement of its teeth with the genus *Scalops* of F. Cuvier."[8]

Scalopus aquaticus aquaticus, the common mole of northeastern United States, in full winter pelage is the darkest of the genus. It is subject to slight local variations in size and color, and even in cranial characters, which, were they constant over any considerable geographic range, might be considered differential enough for subspecific recognition. Specimens from Marthas Vineyard and Nantucket Islands and from the mainland of southeastern Massachusetts average very slightly paler and smaller than typical *aquaticus,* and their skulls are slightly shorter and relatively broader than those from the type locality. Specimens from Liberty Hill, Conn., average large; eastern New York specimens are much like those from the vicinity of Philadelphia, Pa., while those from Long Island are very slightly smaller and possibly more grayish. Toward the south *aquaticus* gradually decreases in size, intergrading with *S. a. howelli* in northern and western North Carolina. A large series from the District of Columbia averages smaller than specimens from the type region, but in all essential characters except size they are typical of *aquaticus*. Dismal Swamp, Va., produces a mole which is as large as the typical form and has a little more tendency toward a mummy brown shade on the back. Material from the Appalachian Mountain region is entirely too scarce to determine the exact relationship and area of intergradation of *aquaticus* with *S. a. machrinus;* a specimen from Roan Mountain, N. C., shows a very slight approach toward *machrinus* in size. A skin without skull from Walden Ridge, Tenn., is here rather arbitrarily referred to *aquaticus* on account of its size and color.

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[1] Pennant, T., Quadrupeds, 1771. The writer has not had access to this publication, but presumes the descriptions are about the same as those in Pennant's History of Quadrupeds, ed. 3, vol. 2, pp. 230, 232, 1793.

[2] Erxleben, J. C. P., Syst. Reg. Anim., p. 118, 1777.

[3] Zimmermann, E. A. W., Spec. Zool. Geog., pp. 496–497, 1777.

[4] Geoffroy Saint Hilaire, É., Cat. Mamm. Mus. Nat. Hist. Nat., p. 78, 1803.

[5] Rafinesque, C. S., Précis des découv. et trav. somiolog., p. 14, 1814.

[6] Desmarest, A. G., Mammalogie, part 1, p. 155, 1820.

[7] Harlan, R., Fauna Amer., p. 33, 1825.

[8] Harlan, loc. cit., p. 34, 1825.

Specimens examined.—Total number, 322, as follows:

Connecticut: Cos Cob, 3; East Hartford, 2; Liberty Hill, 6.[1]

District of Columbia: Washington, 72.

Maryland: Anne Arundel County, 2; Baltimore, 2; Berwyn, 2; Branchville, 5; Cabin John, 1; Capitol View, 1; Chesapeake Beach, 1; Chevy Chase, 1; Highland, 1; Howard County, 1; Landover, 1; Laurel, 11; Mount Rainier, 1; Plummer's Island, 1; Rockville, 2; Seven Locks, 1; Silver Spring, 1; Woodside, 5.

Massachusetts: Holyoke, 1;[1] Middleboro, 1; Nantucket, 6;[1] Wareham, 32;[1] West Tisbury, 4.[1]

New Jersey: Afton, 1; Audubon, 6;[2] Englewood, 1;[3] Fairhaven, 1;[1] Haddonfield, 3.[2]

New York: Brooklyn, 1; Cold Spring Harbor, 1;[3] Cypress Hills, 1;[3] Dobb's Ferry, 1; Dunwoodie, 1;[3] Hastings, Westchester County, 6;[3,4] Lake Grove, 16; Locust Valley, 1;[3] Long Island, 1;[4] Mount Sinai, 2;[3] New Rochelle, 1;[3] New York City, 17;[3,4] Pelham Manor, 1;[3] Oyster Bay, 1; Piermont, 1;[3] Rye, 1;[1] Sing Sing, 15; Southhampton, 1; Tarrytown Heights, 2.[3]

North Carolina: Asheville, 1;[3] Buncombe County, 2;[1] Highlands, 1; Magnetic City, 1; Roan Mountain (altitude 2500 feet), 1; Weaverville, 8.[3,4]

Pennsylvania: Carlisle, 6; Collingdale, 2;[2] Delaware County, 1; Marple, 1;[2] Mechanicsville, 1;[2] Media, 2;[2] Mifflintown, 1; Philadelphia (type locality), 6.[2]

Tennessee: Blount County, 1; Walden Ridge (near Soddy), 1.

Virginia: Alexandria County, 3; Arlington, 3; Bristow, 2; Clark County, 1; Dismal Swamp, 9; Eastville, 1; Falls Church, 9; Fort Myer, 6; Springvale, 1.

West Virginia: Berkeley Springs, 1.

SCALOPUS AQUATICUS HOWELLI Jackson.

Howell's Mole.

(Pl. I, fig. 3; Pl. II, fig. 2; Pl. III, figs. 2, 2a; Pl. VI, fig. 4.)

Scalopus aquaticus howelli Jackson, Proc. Biol. Soc. Washington, vol. 27, p. 19, February 2, 1914.

Type locality.—Autaugaville, Autauga County, Alabama.

Type specimen.—No. 177931, U. S. Nat. Mus., Biological Survey collection; ♂ adult, skin and skull; collected January 4, 1912, by L. S. Golsan.

Geographic range.—North Carolina (except in Appalachian Mountains), South Carolina, northern Georgia, thence southwest across central Alabama and southern Mississippi to Pensacola Bay and the Mississippi River.

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[1] Collection Mus. Comp. Zool., Harvard College.

[2] Collection Acad. Nat. Sci. Philadelphia.

[3] Collection Amer. Mus. Nat. Hist.

[4] Collection Field Mus. Nat. Hist.

General characters.—Intermediate in size between *S. a. aquaticus* and *S. a. australis;* usually paler than either *aquaticus* or *australis;* skull flat, less angular than in *aquaticus;* rostrum long and narrow.

Color.—*Full winter pelage:* Back dark drab, hair-brown, or fuscous, becoming in most specimens buffy brown on head; nose and wrists usually slightly suffused with ochraceous-tawny or cinnamon; underparts more grayish than back, usually much tinged with Saccardo's umber or tawny-olive. *Fresh summer pelage:* Back dark cinnamon-drab or drab, sometimes with a very slight coppery sheen, becoming cinnamon-buff or ochraceous-tawny on face; underparts hair-brown to neutral gray, grading into sepia on chest.

Skull.—Size medium (smaller than that of *S. a. aquaticus,* larger than that of *S. a. australis*) flat; rostrum long and narrow; mandible weak; coronoid process and angle of mandible weak and very narrow, incurved toward condyle, making superior and inferior notches small and relatively deep; teeth small.

Measurements.—Type (adult male): Total length, 152; tail vertebræ, 20; hind foot, 18. *Skull:* Average of 5 skulls of adult males from type locality: Greatest length, 32.3 (31.8–32.7); palatilar length, 13 (12.7–13.3); mastoidal breadth, 16.7 (16.3–17.1); interorbital breadth, 7.2 (7–7.4); maxillary tooth row, 10.1 (10–10.3); mandibular molar-premolar row, 10.1 (9.9–10.2).

Remarks.—Howell's mole differs from both *S. a. aquaticus* and *S. a. australis* in cranial characters and is not strictly intermediate between the two. It shows slight local variations which on account of scarcity of material are not fully understood. Skulls from Bay St. Louis and Washington, Miss., and from New Orleans and St. Tammany Parish, La., have braincases higher and narrower than typical specimens, and the rostra taper more gradually; none of the skulls, however, is from a fully adult animal, and it is possible that age might change this condition. Skulls from Biloxi, Cedarbluff, and Kemper County, Miss., are slightly heavier and more angular than those from the type region. In northern North Carolina *S. a. howelli* begins to approach *aquaticus* in size. A series of specimens from Young Harris, Ga., shows in color a tendency toward *aquaticus* and has skulls which in angularity and height of braincase are like those of *aquaticus*, but which in size and breadth of rostrum are like those of *howelli.* A skin without skull from Pensacola, Fla., is indeterminable, but is provisionally referred to *howelli.*

Specimens examined.—Total number, 106, as follows:

Alabama: Ardell, 1; Auburn, 1; Autaugaville (type locality), 15; Castleberry, 2; Cottondale, 1; Eutaw, 1; Greensboro, 3; Huntsville, 1; Sand Mountain (near Carpenter), 3.

Florida: Pensacola, 1.[1]
Georgia: Columbus, 2; Crawfordsville, 1; Griffin, 1; Young Harris, 12.
Louisiana: New Orleans, 2; St. Francisville, 1; St. Tammany Parish, 1.[2]
Mississippi: Bay St. Louis, 3; Biloxi, 2; Cedarbluff, 1; Kemper County, 1; Washington, 1.
North Carolina: Apex, 1;[3] Bertie County, 1;[1] Jackson, 2; Kinston, 3; Moran, Chowan County, 1; Raleigh, 23; Wilkesboro, 1.
South Carolina: Abbeville, 1;[4] Beaufort County, 4; Calhoun Falls, 1;[3] Catawba, 2;[3] Charleston, 1; Frogmore, 4; Georgetown, 1; Oakley, 2; Society Hill, 1.

SCALOPUS AQUATICUS AUSTRALIS (Chapman).

FLORIDA MOLE.

(Pl. II, fig. 3; Pl. III, figs. 3, 3a; Pl. VI, fig. 5.)

Scalops aquaticus australis Chapman, Bul. Amer. Mus. Nat. Hist., vol. 5, p. 339, December 22, 1893.
Scalopus aquaticus australis Elliot, Field Columb. Mus., publ. 105, zool. series, vol. 6, p. 470, 1905.

Type locality.—Gainesville, Alachua County, Florida.

Type specimen.—No. $\frac{3816}{3250}$, Amer. Mus. Nat. Hist.; young adult, sex unknown, skin and skull; collected May 4, 1891, by F. M. Chapman.

Geographic range.—Southeastern Georgia and the eastern portion of peninsular Florida south to Lemon City.

General characters.—Size small (smaller than *howelli*); feet relatively large; tail relatively short; skull short and broad (relatively broader and higher than that of *howelli*); teeth small.

Color.—*Full winter pelage:* Back clove brown, mummy brown, or dark fuscous, paler on wrists, slightly tinged with ochraceous-buff on nose; underparts similar to back but showing more dark neutral gray at base of hairs. *Worn winter pelage:* Variable; back clove brown or mummy brown to vinaceous-buff, drab, or drab-gray with or without pinkish buff or ochraceous-buff on nose; beneath much as above, more grayish.

Skull.—Small, not angular, less constricted interorbitally than in *S. a. aquaticus*, and not much depressed postorbitally; mastoids not heavy; coronoid process and angle of mandible narrow and weak, the former generally without mammiform process on posterior border; horizontal ramus of mandible weak; teeth small.

Measurements.—Average of 6 adult males from type locality: Total length, 145 (141–150); tail vertebræ, 24.9 (22–28); hind foot, 18 (17–19). Average of 10 adult females from type locality: 138.8 (131–148); 22.6 (21–26); 17.3 (16–18). *Skull:* Average of 6 skulls of adult males from type locality: Greatest length, 31.7 (31.3–32); palatilar length, 12.9 (12.4–13.3); mastoidal breadth, 16.6 (16–16.8); interorbital breadth, 7.2 (7.1–7.3); maxillary tooth row, 9.9 (9.6–10.3); mandibular molar-premolar row, 9.6 (9.4–9.8). Average of 11 skulls of adult females from type locality: Greatest length, 30.4 (29.5–30.8); palatilar length, 12.4 (12–12.7); mastoidal breadth, 16.1 (15.6–16.4); interorbital breadth, 7 (6.7–7.3); maxillary tooth row, 9.6 (9.4–9.7); mandibular molar-premolar row, 9.4 (9.2–9.6).

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[1] Collection Mus. Comp. Zool., Harvard College.
[2] Collection Amer. Mus. Nat. Hist.
[3] Collection Field Mus. Nat. Hist.
[4] Collection Univ. Michigan Mus.

Remarks.—The small size of *S. a. australis*, together with its relatively short, broad, and high skull, readily distinguish it from *S. a. howelli*, its nearest relative toward the north. Its characters are retained very constantly throughout most of its geographic range. Skulls of specimens from St. Catherines Island, Ga., are actually and relatively longer than those of typical *australis*, and in this respect approach *howelli;* in other characters the skulls do not differ essentially from those of typical *australis;* in color these specimens are inseparable from *australis*. A similar though less marked tendency toward *howelli* is noticeable in specimens from Ossabaw Island and Barrington, Ga. South of the type locality *australis* decreases slightly in size; specimens from Oak Lodge and Lemon City, Fla., are of minimum size and average very slightly smaller and darker than those from the type region.

Specimens examined.—Total number, 115, as follows:

Florida: Canaveral, 1; East Micco, 2;[1] Enterprise, 6;[1,2] Eustis, 1; Gainesville (type locality), 25; Georgiana, 1; Indian River, 1; Jacksonville, 3; Lake Harney, 3; Lake Worth, 1; Lemon City, 1; Lynne, 5; New Berlin, 6; [2,3] Micanopy, 2; Oak Lodge (East Peninsula opposite Micco), 21;[3] Orange Hammock, Kissimmee River, 1; Saint Augustine, 1; Saint Charles Creek, 1;[2] West Jupiter, 1.[3]

Georgia: Barrington, 2;[3] Cumberland Island, 2;[3] Hursmans Lake, 10;[3] Montgomery, 3;[3] Nashville, 1; Ossabaw Island, 4;[3] Pinetucky, 3;[3] Saint Catherines Island, 5;[3] Saint Simons Island, 1; Sterling, 1.[3]

SCALOPUS AQUATICUS ANASTASÆ (Bangs).

ANASTASIA ISLAND MOLE.

(Pl. II, fig. 4.)

Scalops anastasæ Bangs, Proc. Boston Soc. Nat. Hist., vol. 28, p. 212, 1898.

Scalops anastasiæ (sic) Elliot, Field Columb. Mus., publ. 45, zool. series, vol. 2, p. 391, 1901.

Scalopus anastasæ Cory, Field Mus. Nat. Hist., publ. 153, zool. series, vol. 11, p. 438, June, 1912.

Type locality.—Point Romo, Anastasia Island, Florida.

Type specimen.—No. 7192, Mus. Comp. Zool., Harvard College, Bangs collection; ♂ adult, skin and skull; collected February 16, 1897, by Outram Bangs.

Geographic range.—Anastasia Island, Fla.

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[1] Collection Amer. Mus. Nat. Hist. [2] Collection Field Mus. Nat. Hist. [3] Collection Mus. Comp. Zool.

General characters.—Size of *S. a. australis:* Fore feet relatively large, nails long and heavy; skull short, massive; mastoids, heavy; rostrum short.

Color.—*Late winter pelage:* Back golden sepia; face, chin, and wrists bright zinc orange; underparts Sudan brown. *Worn winter pelage:* Paler than in late winter pelage with less golden and zinc orange, and showing more light neutral gray of base of hairs.

Skull.—Small, short, and heavy, narrow through mastoids; mastoids heavy; rostrum short; mandible heavy; coronoid process and angle of mandible short; ascending ramus wide; superior notch shallow.

Measurements.—Average of 2 adult males from type locality: Total length, 137.5 (134–141); tail vertebræ, 21.8 (21–22.5); hind foot, 17.8 (17.5–18). *Skull:* Average of 2 skulls of adult males from type locality: Greatest length, 31.5 (31.4–31.6); palatilar length, 12.8 (12.6–12.9); mastoidal breadth, 16.5 (16.4–16.6); interorbital breadth, 7.1 (7–7.1); maxillary tooth row, 10 (9.9–10); mandibular molar-premolar row, 9.7 (9.6–9.8).

Remarks.—Four of the eight moles examined from Anastasia Island are topotypes in the Bangs collection and were collected by Outram Bangs, February 12–16, 1895; the other four are in the Field Museum and were collected by Thaddeus Surber at Espanita, Anastasia Island, January 25–29, 1901. The two series are very unlike. The specimens collected at Espanita have no orange or golden suffusions and can not be separated by skin characters from *S. a. australis* of the mainland; the skulls, however, are shorter than those of typical *australis* and have shorter rostra and slightly heavier mastoids, and in these characters are more like those of *S. a. anastasæ.* In a letter, in regard to these specimens, dated August 19, 1913, Surber states:

> "Espanita" was the home of a Mr. Middleton (a Georgian) located well toward the southern end of the island about 15 miles south of St. Augustine, on the Matanzas River side of island. Most of my work was done in the vicinity of his house, near which I was camped. * * * In the flesh I could never detect any difference between these island moles and those from the mainland. * * * There were no towns nor villages on the island during my visit in 1901, so that I was forced to use this designation (Espanita) for the locality. Mr. Bangs's specimens came from the lower end of the island, I believe, but two or three miles from where these were secured.

Bangs, in a letter to the writer October 23, 1913, referring to the locality where Surber collected, states:

> I am quite sure * * * that that part of the island is quite different from where I was. He got *Peromyscus floridanus* where he was. In the parts of the island I worked I never saw it at all though I trapped hundreds of small mammals. In fact, there was no country suitable to it. Where I caught my moles they were not common. They were in the salt flats and low sandy stretches, where their long tunnels extended about in the white sand and through the flats. There was very little vegetation here except, of course, "sea oats."

All the specimens from Anastasia Island are here provisionally called *anastasæ*, although additional material may result in some change of decision. Were the specimens from Espanita older individuals, their skulls might be inseparable from those from Point Romo. The topotype series was taken about two weeks later in the year than that from Espanita. Two weeks is a short time for changes in the pelage, yet such changes are apparently rapid in *Scalopus*, and it would not be entirely impossible for the full winter pelage of the mole at Espanita to develop before molting into a pelage similar to that of the topotype series.

Specimens examined.—Total number, 8, as follows:

Florida: Espanita, Anastasia Island, 4;[1] Point Romo (type locality), Anastasia Island, 4.[2]

SCALOPUS AQUATICUS PARVUS (Rhoads).

LITTLE MOLE.

(Pl. II, fig. 5; Pl. III, figs. 4, 4a.)

Scalops parvus Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1894, p. 157, 1894.
[*Scalops*] [*aquaticus*] *parvus* Elliot, Field Columb. Mus., publ. 45, zool. series, vol. 2, p. 390, 1901.

Type locality.—Tarpon Springs, Hillsboro County, Florida.

Type specimen.—No. 8468, Acad. Nat. Sci. Philadelphia (No. 1468, Rhoads collection); ♀ adult, skin and skull; collected December 24, 1893, by W. S. Dickinson.

Geographic range.—Region north of Tampa Bay, in Hillsboro and Pasco Counties, Fla.

General characters.—Smallest of the genus; tail relatively short, shorter than that of *S. a. australis;* color much like *australis;* skull small, weak; rostrum very narrow (narrower than that of *australis*).

Color.—*Full winter pelage:* Much like corresponding pelage of *S. a. australis;* back sepia or dark sepia, becoming pinkish cinnamon or ochraceous-buff on nose; underparts slightly paler than back and showing dark neutral gray of base of hairs, sometimes tinged with cinnamon-brown.

Skull.—Like that of *S. a. australis* but smaller, weaker, and with rostrum actually and relatively narrower; teeth small.

Measurements.—Average of 3 adult males from Port Tampa City, Fla.: Total length, 134.3 (131–136); tail vertebræ, 19.7 (19–20.5); hind foot, 16.8 (16.5–17). *Skull:* Average of 3 skulls of adult males from Port Tampa City, Fla.: Greatest length, 30.6 (30.2–31.2); palatilar length, 12.7 (12.5–12.9); mastoidal breadth, 15.7 (15.5–15.8); interorbital breadth, 7.1 (7.1–7.3); maxillary tooth tow, 9.8

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[1] Collection Field Mus. Nat. Hist.

[2] Collection Mus. Comp. Zool, Harvard College.

(9.6–10); mandibular molar-premolar row, 9.7 (9.5–10). Skull of type (probably a female, though sexed "male" by collector): Greatest length, 29.3; palatilar length, 11.9; mastoidal breadth, 15.1; interorbital breadth, 6.6; maxillary tooth row, 9.2; mandibular molar-premolar row, 9.2.

Remarks.—The original description of this form was based upon a single specimen which was unique in collections for several years. True,[1] on account of insufficient material, placed *parvus* in questionable synonymy under *S. a. australis*, where it has since remained. The number of specimens now available from the type region is far from satisfactory, but they show characters sufficient to warrant their separation from *australis*. The type of *S. a. parvus* is in worn pelage; True [2] was inclined to believe on account of the appearance of the skin and the peculiarly worn state of the teeth that the mole had been kept in confinement; there appears no reason for such a conclusion, however, the wear in the teeth and pelage of the type being nothing which might not occur in the normal habitat of the mole. Three males from Port Tampa City, Fla., while distinctly different from *australis*, do not appear to be the extreme type of *parvus;* unfortunately, however, the only specimens from the immediate vicinity of the type locality, except the type, are young.

Specimens examined.—Total number, 9, as follows:

Florida: Belleair, 2; Port Richey, 1;[3] Seven Oaks, 1; [4] Port Tampa City, 3;[5] Tarpon Springs (type locality), 2.[3]

SCALOPUS AQUATICUS MACHRINUS (Rafinesque).

PRAIRIE MOLE.

(Pl. II, fig. 6; Pl. VI, fig. 6.)

Talpa machrina Rafinesque, Atlantic Journ., vol. 1, p. 61, 1832.

Talpa sericea Rafinesque, Atlantic Journ., vol. 1, p. 61, 1832. Type locality near Nicholasville and Harrodsburg, Ky.

Scalops argentatus Audubon & Bachman, Journ. Acad. Nat. Sci. Philadelphia, vol. 8, p. 292, 1842. Type locality southern Michigan.

Talpa Pennantii Le Conte, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 327, 1854. Type locality unknown.

Scalops aquaticus argentatus Coues, Bul. U. S. Geol. & Geog. Surv. Terr., vol. 3, p. 633, 1877.

Scalops (*aquaticus* var.) *argentatus* Herrick, Mamm. of Minnesota, Geol. & Nat. Hist. Surv. Minnesota. Bul. 7, p. 54, 1892.

Scalops aquaticus machrinus True, Proc. U. S. Nat. Mus., vol. 19, p. 20, December 21, 1896.

Scalopus aquaticus machrinus Elliot, Field Columb. Mus., publ. 105, zool. series, vol. 6, p. 470, 1905.

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[1] True, F. W., Proc. U. S. Nat. Mus., vol. 19, p. 21, 1896.

[2] True, loc. cit., p. 34, 1896.

[3] Collection Acad. Nat. Sci. Philadelphia.

[4] Collection of Hartley H. T. Jackson.

[5] Collection Mus. Comp. Zool, Harvard College.

Type locality.—Lexington, Fayette County, Kentucky.

Type specimen.—None known to exist.

Geographic range.—Eastern Iowa, and east of the Mississippi River west of the Appalachian Mountains from western Wisconsin, northern Illinois, southern Michigan, southwestern Ontario (Point Pelee), and northern Ohio, south to central Tennessee.

General characters.—Largest of the genus; tail relatively long; color paler than that of *S. a. aquaticus* and usually more reddish brown; skull flat, broad, heavy, and angular; rostrum massive; teeth very large.

Color.—*Full winter pelage:* Above, sepia, mummy brown, or hair-brown, occasionally showing pinkish buff or cinnamon-buff on nose; underparts more grayish than back and usually tinged with Prout's brown or cinnamon-brown. *Summer pelage:* Slightly paler than winter pelage and usually more grayish.

Skull.—Large, broad, angular, and massive; mastoids very massive; rostrum large; coronoid process and angle of mandible heavy, the former frequently with a distinct secondary process on posterior margin; dentition very heavy.

Measurements.—Adult male from type locality: Total length, 208; tail vertebræ, 38; hind foot, 24. Adult male from Midway, Ky.: 190; 29; 22.5. Adult female from Midway, Ky., 175; 27; 22. Average of 3 adult males from Warsaw, Ill., 199 (194–206), 35.7 (31–38). *Skull:* Adult male from Midway, Ky.: Greatest length, 39.1; palatilar length, 16.7; mastoidal breadth, 20.7; interorbital breadth, 8.2; maxillary tooth row, 12.2; mandibular molar-premolar row, 11.6. Skull of adult female from Midway, Ky.: Greatest length, 37.7; palatilar length, 16.2; mastoidal breadth, 19.2; interorbital breadth, 7.7; maxillary tooth row, 12.1; mandibular molar-premolar row, 11.7. Average of 5 skulls of adult males from Warsaw, Ill.: Greatest length, 39.2 (38.8–39.5); palatilar length, 16.8 (16.6–17); mastoidal breadth, 20.5 (20.3–20.7); interorbital breadth, 7.9 (7.7–8.1); maxillary tooth row, 12.4 (11.9–12.6); mandibular molar-premolar row, 12 (11.5–12.2).

Remarks.—The name *Talpa machrina* Rafinesque[1] and the earliest description of this form were apparently lost to science from shortly after they were published until True[2] resurrected them in 1896; Rafinesque very accurately describes the form and distinctly indicates "near Lexington" as the locality where the species occurred. In the same publication Rafinesque describes another mole, "found in woods near Nicholasville and Harrodsburg," under the name *Talpa sericea*;[3] his second species is clearly the young of his *Talpa machrina*. Audubon and Bachman[4] described a mole from southern Michigan, in 1842, under the name *Scalops argentatus;* although Michigan specimens of *Scalopus* average slightly smaller than typical *S. a. machrinus*, and possibly also slightly paler, the difference is insufficient for subspecific recognition. Le Conte[1] in 1854 described a mole under the name of *Talpa pennantii* which he seemed to believe was the yellow mole of Pennant; Pennant's yellow mole, however, received Latin binomial designation as early as 1777[2] and is purely a synonym of *S. a. aquaticus.* Le Conte states in his description of *T. pennantii* that it "differs from *S. aquaticus* in being much larger (equal in size to *Talpa europæa*) and in having much larger anterior feet."[3] It is evident, therefore, that the specimen he had in hand was probably *S. a. machrinus.*

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[1] Rafinesque, C. S., Atlantic Journ., vol. 1, p. 61, 1832.

[2] True, F. W., Proc. U. S. Nat. Mus., vol. 19, p. 20, 1896.

[3] Rafinesque, loc. cit., p. 62, 1832.

[4] Audubon and Bachman, Jour. Acad. Nat. Sci. Philadelphia, vol. 8, p. 292, 1842.

This large mole retains its characters with remarkable regularity throughout its range. Specimens from the Mississippi Basin in western Wisconsin, as far north as Prescott, Pierce County, are as large as specimens from the type region, if not slightly larger; specimens from eastern Iowa are indistinguishable from specimens from Kentucky. The color tends to become more grayish in northern and western Illinois and in western Wisconsin, possibly indicating an approach toward *S. a. machrinoides.* Moles from Big Sandy and Nashville, Tenn., have somewhat weaker dentition than typical *machrinus* but do not differ essentially in other respects.

Specimens examined.—Total number, 159, as follows:

Illinois: Alton, 2; Belleville, 1; Calhoun, 3;[4] Chicago, 9;[5] Fremont, 1; Hamilton, 1; Joliet, 1;[5] Olive Branch, 1;[5] Olney, 5; Ozark, 1;[5] Parkersburg, 2; Ravenswood, 1;[6] Richland County, 7; Riehl Station, 1; Rosiclare, 1;[5] "Southern Illinois," 3; Union County, 2; Warsaw, 18.

Indiana: Denver, 2;[4] Effner, Newton County, 1; Fort Wayne, 1; Lake Maxinkuckee, 3; Madison, 1; New Lebanon, 1; Waterloo, 2; West Baden, 2;[6] Wheatland, 2.

Iowa: Hillsboro, 1; Knoxville, 1.[5]

Kentucky: Eubanks, 1; Lexington (type locality), 1; Midway, 3.

Michigan: Ann Arbor, 2;[4] Chelsea, 1;[4] Denton, 2;[4] Flushing, 3;[7] Greenfield, 1;[8] Holland, 1;[5] Lansing, 1;[4] Manchester, 1; Milan, 1;[4] Portage Lake, 11;[4] Saline, 1.

Ohio: Cleveland, 1; Fairfield County, 1; Madisonville, 3; Salem, 1.

Ontario: Point Pelee, 25.[8, 9]

Tennessee: Big Sandy, 1; Clarksville, 1; Nashville, 3;[5] Tennessee River, 1.

Wisconsin: Camp Douglas, 2; Durand, 1; Fountain City, 4;[6] Maiden Rock, 3;[6] Prescott, 1;[6] Wyalusing, 4.[6]

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[1] Le Conte, Joseph, Proc. Acad. Nat. Sci., Philadelphia, vol. 6, 1853, p. 327, 1854.

[2] *Talpa europæa flavescens* Erxleben (Syst. Reg. Anim., p. 118)and *Talpa flava* Zimmermann (Spec. Zool. Geog. p. 497).

[3] Le Conte, loc. cit.

[4] Collection Univ. Michigan Mus.

[5] Collection Field Mus. Nat. Hist.

[6] Collection Milwaukee Public Mus.

[7] Collection of Hartley H. T. Jackson.

[8] Collection Victoria Mem. Mus.

[9] Collection of W. E. Saunders, London, Ontario.

SCALOPUS AQUATICUS MACHRINOIDES Jackson.

MISSOURI VALLEY MOLE.

(Pl. II, fig. 7.)

Scalopus aquaticus machrinoides Jackson, Proc. Biol. Soc. Washington, vol. 27, p. 19, February 2, 1914.

Type locality.—Manhattan, Riley County, Kansas.

Type specimen.—No. 169717, U. S. Nat. Mus., Biological Survey collection; ♂ adult, skin and skull; collected June 1, 1910, by W. E. Berg.

Geographic range.—West of the Mississippi River, except eastern Iowa, from central Minnesota, southeastern South Dakota, and the eastern border of Nebraska, south through northeastern Kansas to extreme northern Arkansas.

General characters.—Size large, exceeded only by *S. a. machrinus;* color more grayish than *machrinus;* skull heavy, angular, smaller than that of *machrinus,* with a shorter rostrum, and relatively smaller inferior mandibular notch.

Color.—*Winter pelage:* Upperparts ranging from bister to clove brown, becoming paler on face and wrists; underparts slightly paler than back, and usually showing more slate color of base of hairs, washed ventrally with raw umber or mummy brown. *Summer pelage:* Upperparts light drab, drab, or wood brown, paler on face, nose, and ankles; beneath slightly paler than back, more grayish.

Skull.—Most nearly like that of *S. a. machrinus* but smaller, with a relatively shorter rostrum; ascending ramus of mandible not so heavy as in *machrinus,* and inferior mandibular notch smaller; rostrum short and broad; molariform dentition very heavy.

Measurements.—Average of 3 adult males from Elk River, Minn.: Total length, 172 (168–178); tail vertebræ, 30 (27–32); hind foot, 22.2 (22–22.5). Average of 3 adult females from Fort Leavenworth, Kans., Bismarck, Mo., and Council Bluffs, Iowa: 181 (180–182); 32 (31–33); 22.3 (22–23). *Skull:* Average of 3 skulls of adult males from type locality: Greatest length, 37.1 (36.2–37.7); palatilar length, 15.3 (15.2–15.5); mastoidal breadth, 19.4 (19.3–19.5); interorbital breadth, 8 (7.9–8.1); maxillary tooth row, 12 (11.8–12.1); mandibular molar-premolar row, 11.8 (11.5–12).

Remarks.—The Mississippi River separates the range of *S. a. machrinus* from that of *S. a. machrinoides* except for a short distance where the former extends into Iowa. Specimens from St. Louis, Mo., are somewhat intermediate between the two forms, being larger than typical *machrinoides* and having relatively longer rostra. Toward the north (Elk River, Minn.), *machrinoides* decreases slightly in size; along the western border of its range it intergrades with *S. a. caryi,* specimens from Lincoln, Nebr., being smaller and paler than typical *machrinoides*, while those from Vermilion, S. Dak., though large, are distinctly paler than the typical form and have higher, more rounded skulls. Two specimens from Carthage, Mo., and one from Winslow, Ark., are smaller than specimens from the type region, and have smaller teeth and narrower rostra; the heavy mastoids and the massive skulls are much as in *machrinoides*. A series from Greenway, Ark., shows a very slight approach toward *S. a. pulcher* in color and width of rostrum, but is easily referable to *machrinoides*.

Specimens examined.—Total number, 77, as follows:

Arkansas: Greenway, 7;[1] Winslow, 1.

Iowa: Council Bluffs, 1.

Kansas: Burlington, 1; Fort Leavenworth, 4; **Manhattan (type locality)**, 6; Neosho Falls, 2; Onaga, 2; Stillwater Creek, 1.

Minnesota: Elk River, 4; Fort Snelling, 2.

Missouri: Bismarck, 1; Carthage, 2;[2] Charleston, 1; Columbia, 11; Independence, 1; Marble Hill, 1; St. Louis, 7; Stotesbury, 9.[3]

Nebraska: Everett, 1; Fort Crook, 2;[4] Lancaster County, 1;[5] Lincoln, 5;[5] Perch, 1.[4]

South Dakota: Big Sioux River (at mouth), 1; Vermillion, 2.[6]

SCALOPUS AQUATICUS PULCHER Jackson.

ARKANSAS MOLE.

(Pl. II, fig. 8.)

Scalopus aquaticus pulcher Jackson, Proc. Biol. Soc. Washington, vol. 27, p. 19, February 2, 1914.

Type locality.—Delight, Pike County, Arkansas.

Type specimen.—No. 170698, U. S. Nat. Mus., Biological Survey collection; ♂ adult, skin and skull; collected January 20, 1911, by W. G. Savage.

Geographic range.—Humid lowland region of southern and eastern Arkansas, southeastern Oklahoma, northwestern and central Louisiana, and eastern Texas.

General characters.—About the size of *S. a. aquaticus*; hind foot larger; skull larger than that of *aquaticus*, flatter, less swollen supraorbitally, wider interorbitally; interparietal wider than in *aquaticus;* skull narrower through mastoids than that of *S. a. machrinoides*, with narrower rostrum and smaller teeth. Slightly larger than *Scalopus æreus;* skull relatively wider interorbitally, through mastoids and through rostrum, flatter and more angular.

Color.—*Full winter pelage:* Back dark fuscous with many hairs tipped with pearl gray, producing in places a slightly frosted appearance; top of head mummy brown; nose cinnamon-brown; underparts sepia, showing much blackish plumbeous of base of hairs. *Worn winter pelage:* Above fuscous or olive-brown, usually tinged on head with mummy brown or Saccardo's umber; underparts dark neutral gray, becoming paler anteriorly, tinged with bister. *Fresh summer pelage:* Upperparts olive-brown shading into coppery seal brown on head and face; nose and wrists slightly tinged with ochraceous-orange; beneath, bright cinnamon, becoming grayish posteriorly.

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[1] Collection Field Mus. Nat. Hist.

[2] Collection of Hartley H. T. Jackson.

[3] Collection Mus. Comp. Zool., Harvard College.

[4] Collection Amer. Mus. Nat. Hist.

[5] Collection Univ. Nebraska.

[6] Collection Univ. South Dakota.

Skull.—Somewhat similar to that of *S. a. aquaticus*, but slightly larger, less angular, with flatter braincase, and averaging wider interorbitally and through mastoids; postorbital region less depressed than in *aquaticus*, zygomata heavier posteriorly, and horizontal ramus of mandible more arched ventrally; no distinct secondary process on posterior margin of coronoid process, though central portion of posterior border of ascending ramus is sometimes slightly expanded posteriorly.

Measurements.—Average of 6 adult males from type locality: Total length, 155.9 (153–170); tail vertebræ, 25 (23–29); hind foot, 22 (21–23). Average of 3 adult females from type locality: 149.3 (146–156); 23.3 (20–25); 21 (20–22). *Skull:* Average of 7 skulls of adult males from type locality: Greatest length, 35.6 (34.7–37.4); palatilar length, 14.7 (14.2–15.4); mastoidal breadth, 18.2 (17.6–19.2); interorbital breadth, 7.8 (7.5–8.2); maxillary tooth row, 11.3 (11–11.7); mandibular molar-premolar row, 11 (10.8–11.5). Average of 3 skulls of adult females from type locality: Greatest length, 34.3 (34.1–34.6); palatilar length, 14.3 (14.2–14.4); mastoidal breadth, 18 (17.5–18.3); interorbital breadth, 7.7 (7.4–8); maxillary tooth row, 10.9 (10.7–11); mandibular molar-premolar row, 10.7 (10.6–10.8).

Remarks.—Like other members of the genus, this beautiful mole is subject to slight local variations throughout its range. Specimens from Grand Coteau and Clarks, La., are somewhat smaller than the typical form; one from Clarks is unusually grayish for the form, but the much-worn fur and the partial molt may account for the color. The very few not immature in a series from Mer Rouge, La., are much alike in color, but are not so richly colored as most specimens of *S. a. pulcher;* skulls of males, however, show the greatest individual variation observed in any series from a single locality; two skulls are indistinguishable from topotype skulls of *pulcher;* two others are long, narrow, high, and rotund, and have narrow rostra; another is short, broad, and flat, and has a broad rostrum; age may possibly account for some of the variation, and incorrect sex determinations may also be partly responsible. An old male from Lake City, Ark., is in some respects intermediate between *pulcher* and *S. a. machrinoides;* the teeth are large; the mastoids almost as heavy as those of *machrinoides;* and the rostrum is slightly heavier than that of typical *pulcher*, but in size and other characters it is very similar to skulls from the type locality. The specimen is in very fresh spring pelage, a little of the winter fur remaining on nose and rump, and in color it seems to be more nearly like *machrinoides* than *pulcher*. A specimen from Fort Smith, Ark., and one from Wister, Okla., neither adult, are referable to *pulcher*.

Specimens examined.—Total number, 67, as follows:

Arkansas: Camden, 1; Delight (type locality), 15; Lake City, 1; Fort Smith, 1; Wilmot, 1.
Louisiana: Clarks, 1; Columbia, 1;[1] Grand Coteau, 1; Mer Rouge, 23; Natchitoches, 1; Shreveport, 3.
Oklahoma: Wister, 1.[2]
Texas: Joaquin, 1; Sour Lake, 16.

SCALOPUS AQUATICUS CARYI Jackson.

NORTHERN PLAINS MOLE.

(Pl. II, fig. 9.)

Scalopus aquaticus caryi Jackson, Proc. Biol. Soc. Washington, vol. 27, p. 20, February 2, 1914.

Type locality.—Neligh, Antelope County, Nebraska.

Type specimen.—No. 116799, U. S. Nat. Mus., Biological Survey collection; ♂ young adult, skin and skull; collected September 18, 1901, by Merritt Cary.

Geographic range.—Arid and semiarid plains region of central and western Nebraska, northeastern Colorado, and northwestern Kansas.

General characters.—Size medium; tail long; color palest of the genus; most nearly like *S. a. intermedius* but much paler and lacking ochraceous suffusions on nose and wrists; skull slightly shorter than that of *intermedius* and relatively broader interorbitally.

Color.—*Autumn pelage:* Back light drab slightly tending toward avellaneous, becoming paler on head and shading in some cases into ivory yellow on nose; underparts much the same color as back, more mixed with neutral gray and occasionally washed with Saccardo's umber or cinnamon-brown.

Skull.—Size moderate, short, broad, and rotund; rostrum short; mandible heavy; dentition relatively heavy. Very similar to the skull of *S. a. intermedius* but slightly shorter and relatively broader interorbitally. Compared with the skull of *S. a. pulcher* that of *S. a. caryi* is shorter and higher, wider interorbitally, and has weaker mastoids, shorter, wider rostrum, and larger teeth; it is larger, much higher, and more massive than the skull of *S. æreus*, and is much smaller, higher, and less angular than that of *S. a. machrinoides*, though in extreme old age it tends to become angular and the braincase flattens.

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[1] Collection Field Mus. Nat. Hist.

[2] Collection Carnegie Mus.

Measurements.—Average of 3 males from type locality: Total length, 159 (157–160); tail vertebræ, 32 (31.5–32.5); hind foot, 21.1 (20.3–22). *Skull:* Average of 3 skulls of males from type locality: Greatest length, 34.2 (33.1–34.8); palatilar length, 14.2 (14.1–14.4); mastoidal breadth, 17.8 (17–18.4); interorbital breadth, 8.1 (7.7–8.4); maxillary tooth row, 11.2 (11.1–11.3); mandibular molar-premolar row, 10.9 (10.8–11).

Remarks.—This subspecies can be distinguished from all other moles by its pale color and lack of ochraceous suffusions. Its nearest relationships are with *intermedius* with which it probably intergrades in southern Kansas.

Specimens examined.—Total number 16, as follows:

Colorado: Wray, 1.
Kansas: Long Island, 3.[1]
Nebraska: Kennedy, 1; Neligh (type locality), 4; Long Pine, 2;[2] Niobrara River, 1;[3] "Sandhills," 1; Warbonnet Canyon, Sioux County, 3.[3]

SCALOPUS AQUATICUS INTERMEDIUS (Elliot).

SOUTHERN PLAINS MOLE.

Scalops machrinus intermedius Elliot, Field Columb. Mus., publ. 37, zool. series, vol. 1, p. 280, 1899.
[*Scalops*] [*aquaticus*] *intermedius* Elliot, Field Columb. Mus. publ. 45, zool. series, vol. 2, p. 390, 1901.
Scalopus aquaticus intermedius Bailey, N. Am. Fauna No. 25, p. 207, October 24, 1905.

Type locality.—Alva, Woods County, Oklahoma.

Type specimen.—No. 6832, Field Mus. Nat. Hist.; ♂ adult, skin and skull; collected February 23, 1899, by Thaddeus Surber.[4]

Geographic range.—Central and western Oklahoma and adjacent parts of northern Texas.

General characters.—Size medium; tail relatively long; color pale with ochraceous on nose and wrists, darker and more ochraceous than *caryi;* skull relatively short, high and heavy, but not angular; rostrum short; teeth large.

Color.—*Winter pelage:* Back light drab to drab tinged with buff-pink; nose and wrists ochraceous-buff to zinc orange; underparts slightly paler than back, more silvery and showing less buff-pink; base of hairs deep neutral gray. *Young:* More plumbeous than adults, darker, less pink-buff tinge on back and little or no ochraceous-buff on nose and wrists.

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[1] Collection Amer. Mus. Nat. Hist.

[2] Collection Stanford Univ.

[3] Collection Univ. Nebraska.

[4] Mr. C. B. Cory, in a letter dated March 20, 1914, advises the writer that the specimen labeled as the type of *Scalops machrinus intermedius* Elliot is No. 6829, Field Mus. Nat. Hist., collected at Alva, Okla., December 8, 1899, by Thaddeus Surber. In the original description Elliot designates no type specimen by number, but describes an adult male collected at Alva, Okla., February 23, 1899, by Thaddeus Surber. Since No. 6832, Field Mus. Nat. Hist. is the only specimen of the original series to which this description can apply, it is necessary to consider it the type of *intermedius.*

Skull.—Resembles that of *S. a. caryi* in nearly every particular, but averages slightly larger, is usually slightly more depressed postorbitally, and has relatively heavier molariform dentition.

Measurements.—Average of 4 adult males from type locality: Total length, 164.5 (160–169); tail vertebræ, 28.8 (27–31); hind foot, 21.8 (21–22). *Skull:* Average of 4 skulls of adult males from type locality: Greatest length, 35 (34.5–35.6); palatilar length, 14.7 (14.5–14.9); mastoidal breadth, 18.3 (17.8–18.5); interorbital breadth, 8.1 (7.8–8.3); maxillary tooth row, 11.4 (10.9–11.7); mandibular molar-premolar row, 11.1 (10.5–11.4).

Remarks.—The subspecies *intermedius* can be distinguished from its nearest congener, *S. a. caryi,* by its slightly darker color, and, in full adult pelage, by the ochraceous-buff or zinc orange on nose and wrists; the skull of *intermedius* is generally longer than that of *caryi.* Specimens from Mount Scott, Okla., are a little darker than typical *intermedius,* and the skulls are slightly longer. Intergradation between this subspecies and *S. a. texanus* apparently occurs in north-central Texas. It seems probable that *intermedius* intergrades also with *S. a. pulcher* in eastern Oklahoma, though specimens from Red Fork, Okla., show no approach to *pulcher.* An alcoholic specimen from Belknap, Tex., too young for positive identification, is provisionally referred to *intermedius.*

Specimens examined.—Total number, 22, as follows:

Oklahoma: Alva (type locality), 6; Dougherty, 1;[1] Fort Reno, 1; Mount Scott, 5; Red Fork, 3.

Texas: Belknap, 1; Lipscomb, 3; Mobeetie, 2.

SCALOPUS AQUATICUS TEXANUS (Allen).

TEXAS MOLE.

(Pl. II, fig. 10; Pl. III, figs. 5, 5a; Pl. VI, fig. 7.)

Scalops argentatus texanus Allen, Bul. Amer. Mus. Nat. Hist., vol. 3, p. 221, April 29, 1891.

Scalops texanus Allen, Bul. Amer. Mus. Nat. Hist., vol. 5, p. 200, 1893.

Scalops aquaticus texanus True, Proc. U. S. Nat. Mus., vol. 19, p. 21, 1896.

[*Scalops*] [*aquaticus*] *texensis* (sic) Elliot, Field Columb. Mus., publ. 45, zool. series, vol. 2, p. 390, 1901.

Scalopus aquaticus texanus Bailey, N. Am. Fauna No. 25, p. 206, October 24, 1905.

Scalopus aquaticus texensis (sic) Elliot, Field Columb. Mus., publ. 105, zool. series, vol. 6, p. 471, 1905.

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[1] Collection Field Mus. Nat. Hist.

Type locality.—Rockport, Aransas County, Texas.

Type specimen.—No. $\frac{3488}{2740}$, Amer. Mus. Nat. Hist.; sex unknown; skin and skull; collected September, 1887, by William Lloyd.

Geographic range.—Coast region of Texas from Matagorda Bay to Cameron County, north in the interior to central and east-central Texas.

General characters.—Size small; much smaller, darker, and more brownish than *intermedius;* back generally much tinged with bronze, and nose and wrists suffused with orange; skull small, flat, much depressed postorbitally, and swollen supraorbitally; rostrum short; teeth large.

Color.—Full winter pelage: Back Saccardo's umber to mummy brown with bronze tinge; nose and wrists zinc orange to xanthine orange; underparts much like back, less bronze, occasionally tinged with amber-brown; base of hairs dark mouse gray dorsally, becoming slightly paler ventrally. *Fresh summer pelage:* Slightly paler than winter pelage, less brown, with less orange on nose and wrists; underparts distinctly more grayish than in winter pelage.

Skull.—Small, flat, constricted interorbitally, much depressed postorbitally, and swollen supraorbitally; rostrum short; mandible relatively heavy; teeth relatively large. The skull of *S. a. texanus* is very much smaller than that of *S. a. intermedius* or *S. a. pulcher;* about the size of that of *S. a. australis* but differs from it in shape and in having much heavier mandibles and dentition.

Measurements.—Average of 8 adult males from type locality: Total length, 138.5 (128–152); tail vertebræ, 23.8 (21–26); hind foot, 17.2 (15.5–18). Average of 4 adult females from type locality: 133.8 (130–137); 22.3 (20–24); 16.3 (15–17). *Skull:* Average of 9 skulls of adult males from type locality: Greatest length, 31 (30–32); palatilar length, 13 (12.7–13.7); mastoidal breadth, 16.6 (16.1–17); interorbital breadth, 6.8 (6.6–7.1); maxillary tooth row, 10.3 (10–10.6); mandibular molar-premolar row, 10.1 (9.7–10.3). Average of 4 skulls of adult females from type locality: Greatest length, 29.8 (29.3–30.2); palatilar length, 12.6 (12.3–12.8); mastoidal breadth, 16.2 (15.9–16.5); interorbital breadth, 6.9 (6.7–7.1); maxillary tooth row, 9.8 (9.7–9.9); mandibular molar-premolar row, 9.7 (9.5–9.9).

Remarks.—Local variation in the genus seems to reach its maximum in *S. a. texanus,* there being no two localities from which specimens of this form have been examined but exhibit differences either in skin or cranial characters, or in both; there is, however, very little individual variation in a series from any one locality. Unfortunately, no considerable number of specimens are available except from Rockport, Tex., and until extensive series of specimens and careful habitat studies are obtained from each of many localities it will be impossible to determine the extent and meaning of these variations. The large series from the type locality is remarkably uniform in characters except for seasonal color variations. Skulls from Corpus Christi are slightly larger, higher through the braincase, and broader through the rostrum than typical *texanus*, as are also two believed to have been collected at Brownsville, Tex.; specimens from Padre Island are very slightly longer than those from Rockport; one from Santa Rosa is high and weak and has a rather short rostrum. The color of the Santa Rosa specimen is much paler than that of typical *texanus* due probably to the peculiar condition of the pelage. Specimens from Mason have large skulls and pale color and in these respects seem to approach *S. a. intermedius;* the skulls, however, are flat and have narrow rostra. A skin without skull from Waco is inclined toward *intermedius* in color, but is much too small for that form and has been provisionally called *texanus;* another skin, in very soiled pelage, from Longpoint, Tex., does not differ from typical *texanus* in size or color.

Specimens examined.—Total number, 42, as follows:

Texas: Brownsville, 2; Corpus Christi, 2; Longpoint, 1; Mason, 3; Padre Island, 3; Rockport (type locality), 25; San Antonio, 4; Santa Rosa, 1; Waco, 1.[1]

SCALOPUS ÆREUS (Bangs).

Coppery Mole.

(Pl. II, fig. 12; Pl. III, figs. 7, 7a; Pl. VI, fig. 9.)

Scalops texanus æreus Bangs, Proc. Biol. Soc. Washington, vol. 10, p. 138, December 28, 1896.

[*Scalops*] *æreus* Elliot, Field Columb. Mus., publ. 45, zool. series, vol. 2, p. 390, 1901.

Scalops aquaticus æreus Miller & Rehn, Proc. Boston Soc. Nat. Hist., vol. 30, p. 250, December, 1901.

Scalopus æreus Elliot, Field Columb. Mus., publ. 105, zool. series, vol. 6, p. 471, 1905.

Scalopus aquaticus æreus Miller, U. S. Nat. Mus., Bul. 79, p. 8, December 31, 1912.

Type locality.—Stilwell, Payne County, Oklahoma.

Type specimen.—No. 5475, Mus. Comp. Zool., Harvard College, Bangs collection; ♀ adult, skin and skull; collected August 13, 1896, by Thaddeus Surber.

Geographic range.—Known only from type locality.

General characters.—Size medium; differs from all other forms of *Scalopus* in its color, a rich coppery snuff brown; skull weak and narrow.

Color.—Type (female), in *late summer pelage:* Upperparts rich coppery snuff brown; underparts less coppery than above, more grayish.

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[1] Collection Acad. Nat. Sci. Philadelphia.

Skull.—Much smaller, weaker, and narrower than that of *S. a. machrinoides*, *S. a. pulcher*, or *S. a. intermedius;* larger than that of *S. a. texanus*, relatively longer, less depressed postorbitally and less swollen supraorbitally, with longer, narrower rostrum; teeth small.

Measurements.—Type (adult female): Total length, 154; tail vertebræ, 24; hind foot, 19. *Skull* (of type): Greatest length, 33.2; palatilar length, 14; mastoidal breadth, 17; interorbital breadth, 7.5; maxillary tooth row, 10.6; mandibular molar-premolar row, 10.5.

Remarks.—The status and relationships of this form are unknown. The type and only specimen in collections was taken August 13, 1896; the rich coppery color may be due in part to a deadening of the summer fur preceding molt and if such proves to be the case the coppery color will not be of diagnostic value. The skull is weak, narrow, moderately high and rounded, and has a long, narrow rostrum; the teeth are much worn, the sutures closed, and from all appearances the animal was adult; it was sexed female by the collector.

Specimen examined.—One, the type.

SCALOPUS INFLATUS Jackson.

TAMAULIPAS MOLE.

(Pl. II, fig. 11; Pl. III, figs. 6, 6a; Pl. VI, fig. 8.)

Scalopus inflatus Jackson, Proc. Biol. Soc. Washington, vol. 27, p. 21, February 2, 1914.

Type locality.—State of Tamaulipas, Mexico (45 miles from Brownsville, Texas).

Type specimen.—No. 52709, U. S. Nat. Mus., Biological Survey collection; young adult, sex unknown; skin and imperfect skull; collected in 1892 by F. B. Armstrong.

Geographic range.—Known only from type locality.

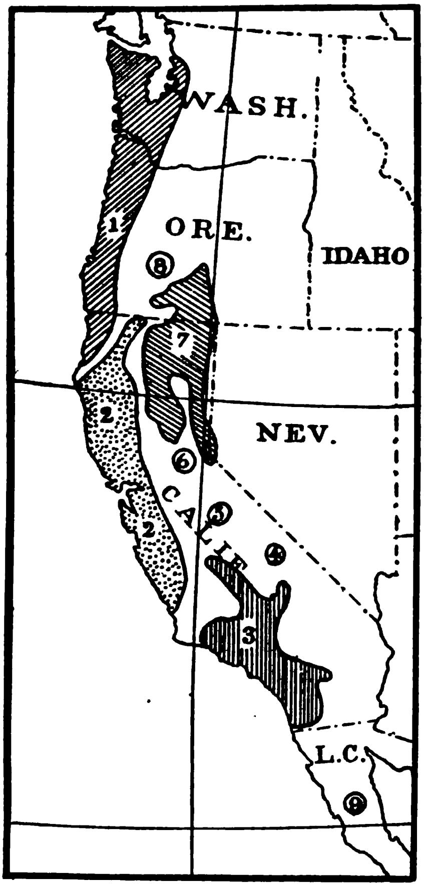
General characters.—Size small, larger than *S. a. texanus;* skull broad, high, and arched, much inflated in prelachrymal region; rostrum broad, truncate; zygomata heavy.

Color.—Back between wood brown and drab, becoming ochraceous-buff on cheeks; general tone of underparts much as on back but more mixed with mouse gray.

Skull.—Size medium, high and arched; prelachrymal region much swollen; audital bullæ high and well defined; zygomata heavy; posterior edge of lachrymal foramen meets zygoma at nearly right angle; rostrum broad; mandible heavy, horizontal ramus much arched ventrally; outer groove in third upper premolar pronounced; first lower premolar small and inconspicuous.

Measurements.—Type (from dry skin, foot relaxed): Tail vertebræ, 18; hind foot, 16.5. *Skull* (of type): Palatilar length, 13.4; mastoidal breadth, 17; interorbital breadth, 7.1; maxillary tooth row, 11.1; mandibular molar-premolar row, 11.

Remarks.—The only-known specimen of this form is imperfect; it lacks complete data, the pelage is ragged and apparently faded, and the posterior portion of the braincase is broken away. Aside from its many other distinctive characters, *Scalopus inflatus* can easily be separated from all other members of the genus by the peculiarly inflated prelachrymal region of the skull. It was at first thought that this inflation was due to parasites; but the bilateral symmetry of the inflations, the fact that no apparent work of parasites has been noticed in this region of the skull in the many hundred specimens of *Scalopus* examined, and, further, the fact that a very slight and inconspicuous tendency toward prelachrymal inflation is present in all members of the genus, leads to the belief that the inflation in this species is an extreme accentuation of normal development.



B2013-103

FIG. 7.—Geographic range of the species and subspecies of *Scapanus* except *S. orarius* (see fig. 12).

1. *S. townsendii.*
2. *S. latimanus latimanus.*
3. *S. l. occultus.*
4. *S. l. grinnelli.*
5. *S. l. sericatus.*
6. *S. l. minusculus.*
7. *S. l. dilatus.*
8. *S. l. alpinus.*
9. *S. anthonyi.*

Specimen examined.—One, the type.

Genus SCAPANUS Pomel.

Scapanus Pomel, Archives Sci. Physiques et Nat., tome 9, p. 247, November, 1848.

Scaphanus Herrick, Geol. and Nat. Hist. Surv., Minnesota, Bul. 7, p. 55, 1892.

Scapasius Beddard, Cambridge Nat. Hist., vol. 10, p. 518, 1902.

Type species.—*Scalops townsendii* Bachman.

Geographic range. — Southwestern British Columbia (Fraser River region), western and southern Washington, western Oregon, extreme western Nevada, California (except the southeastern desert region), south to San Pedro Martir Mountains, Lower California (figs. 7 and 12).

External characters.—Body robust, depressed; tail short, round, thick and fleshy, tapering apically and slightly constricted proximally, indistinctly annulated, scantily haired with coarse hairs (fig. 8). Head conoidal, depressed. Nose elongated into a snout (shorter and less truncate than in *Scalopus*), the apical portion naked to line of anterior edge of nasals; nostrils superior, crescentic, with concavities turned in laterally (fig. 9). Eyes minute, concealed in fur. Auricular orifice small. Legs short and stout. Feet large, fleshy, scantily haired above, naked below. Fore feet handlike, the palms as broad as long (fig. 10). Soles of hind feet with one to three (usually two) distinct tubercles. Fore toes and hind toes not webbed. Claws of fore feet broad, flat, and heavy; those of hind feet relatively short and weak (fig. 11). Fur dense, soft, silky, the hairs nearly equal in length, producing a velvetlike pelage. Mammæ, 8: latero-pectoral, 2–2; latero-abdominal, 1–1; inguinal, 1–1.

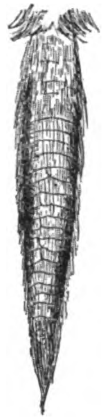

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Fig. 8.—Tail of *Scapanus latimanus latimanus* (× 1½). No. 105258, U. S. Nat. Mus.; from Colma, San Mateo County, Cal.

Skeletal characters.—Clavicle short and heavy, about three-fourths as broad as long, distinctly notched on the inferior border, not penetrated by a foramen. Humerus heavy, about three-fourths as broad as long. Pelvis narrow, bones of opposite sides scarcely touching under acetabula; two osseous bridges, each bifurcate posteriorly, connect sacral vertebræ with ischium and produce six foramina or openings, a large one in each of the anterior angles formed by median lines of acetabula and sacral vertebræ and two smaller ones in each of the posterior angles. Superior surface of last sacral vertebra without longitudinal process. Os falciforme relatively broad and long, reaching proximal end of terminal phalange of first digit, gently incurved, not much tapering distally.

Skull conoidal, flat, with relatively broad braincase, and slightly constricted interorbitally. Mastoids moderately heavy, not prominent. Interparietal large, somewhat rectangular, breadth (antero-posterior diameter) about one-third the length, slightly convex anteriorly and concave posteriorly with a posterior median projection. Frontal region flat, not much sloping; frontal sinuses somewhat swollen. Rostrum moderately long; anterior ends of premaxillæ slightly thickened and extending beyond nasals, forming a notch (acute to truncate) anterior to nasals. Anterior nares opening forward. Zygomata moderately long and heavy, rather sharply curved inward anteriorly, the posterior end attached about medially on squamosal. Foramen magnum oval, of moderate size. Infraorbital

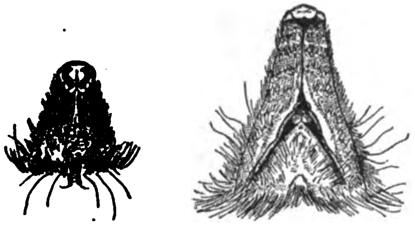
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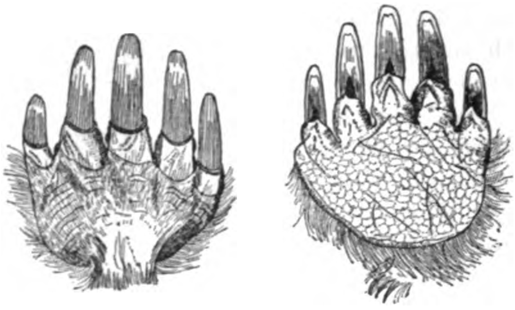
Fig. 9.—Snout of *S. l. latimanus* (× 1½). Individual referred to in fig. 8.

foramen relatively small (larger than in *Scalopus*), the plate forming its outer wall moderately broad. Audital bullæ complete, depressed; auditory meatus short (more developed than in *Scalopus*). External pterygoid region moderately inflated both posteriorly and anteriorly. Mesopterygoid space moderately broad and relatively long, the sides nearly straight and slightly converging posteriorly. Palate moderately elongate, terminating at a distance posterior to the last molar about equal to half the diameter of that tooth; posterior border of palate truncate or slightly emarginate, usually with a slight median notch. Anterior palatine foramina moderate, oval to elliptical-oval; posterior palatine foramina small (the first pair larger than the second), round to oval. Horizontal ramus of mandible moderately heavy, somewhat curved upward at posterior end, nearly straight at anterior end; coronoid moderately elongate, quadrate, truncate, directed almost perpendicular to median line of horizontal ramus; angle of mandible large and heavy (relatively longer than in *Scalopus*); inferior mandibular notch large, subcircular, relatively broad and deep.



B2016-103

Fig. 10.—Fore foot of *S. l. latimanus* (× 1½). Individual referred to in fig. 8.

Dental characters.—First upper incisor long and broad, convex anteriorly, flat posteriorly; second and third upper incisors and upper canine simple, conical, of moderate size, subequal, about two-thirds as long as first incisor. First, second, and third upper premolars similar to second and third incisors, the third premolar usually with a small postero-basal cusp; fourth premolar much larger than third, more cuspidate, with a large posterior cusp, usually with an intero-basal cusplike process, and frequently with a more or less developed antero-basal cusplike process. Upper molars W-shaped in transverse section, with an antero-internal V-shaped cusplike shelf (not lobed); first and second molars subequal, the third much smaller.

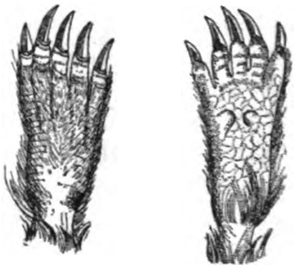


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Fig. 11.—Hind foot of *S. l. latimanus* (× 1½). Individual referred to in fig. 8.

First seven lower teeth (incisors, canine, and first, second, and third premolars) small, conical, the first and third incisors smaller than the other teeth, which are subequal; premolars each with a slight cusplike process posteriorly; fourth premolar much larger, more cuspidate. Lower molars M-shaped in transverse section, the antero-internal cusp bilobed; first molar with a postero-internal basal accessory cusp; second molar with a postero- and an antero-internal basal accessory cusp; third molar with an antero-internal basal accessory cusp; first and second molars subequal, the third much smaller. Dentition: i. $\frac{3}{3}$; c. $\frac{1}{1}$; pm. $\frac{4}{4}$;[1] m. $\frac{3}{3}$; total 44.

Key to Species and Subspecies of Scapanus.

[Based upon specimens of adult animals in fresh pelage.]

a^1. Unicuspid teeth evenly spaced and not crowded; rostrum relatively long and narrow; color dark, almost black (except in *Scapanus orarius schefferi*).

- b^1. Total length more than 200 mm.; greatest length of skull more than 40 mm.; sublachrymal-maxillary ridge distinct..........*Scapanus townsendii* (p. 58).
- b^2. Total length less than 200 mm.; greatest length of skull less than 40 mm.; sublachrymal-maxillary ridge not much developed.
  - c^1. Color darker; rostrum narrow; interorbital breadth of skull 8.2 mm. or less, *Scapanus orarius orarius* (p. 61).
  - c^2. Color paler; rostrum relatively broad; interorbital breadth of skull 8.2 mm. or more..................................*Scapanus orarius schefferi* (p. 63).

a^2. Unicuspid teeth usually crowded and not evenly spaced; rostrum relatively short and broad; color usually brown or gray, seldom almost black.

- b^1. Total length usually less than 165 mm.; greatest length of skull 33.5 mm. or less.
  - c^1. Greatest length of skull less than 31 mm.; premolars $\frac{3}{3}$, *Scapanus anthonyi* (p. 75).
  - c^2. Greatest length of skull 31 mm. or more; premolars $\frac{4}{4}$.
    - d^1. Interorbital constriction more than 7.6 mm.; breadth of skull across mastoids more than 16.2 mm............*Scapanus latimanus grinnelli* (p. 69).
    - d^2. Interorbital constriction 7.6 mm. or less; breadth of skull across mastoids 16.2 mm. or less.
      - e^1. Inferior mandibular notch deep; geographic range south of latitude 37° N............................*Scapanus latimanus occultus* (p. 68).
      - e^2. Inferior mandibular notch shallow; geographic range north of latitude 37° N.........................*Scapanus latimanus minusculus* (p. 72).
- b^2. Total length usually more than 165 mm.; greatest length of skull more than 33.5 mm.
  - c^1. Geographic range, California west of Sacramento and San Joaquin Valleys, including also Klamath Canyon......*Scapanus latimanus latimanus* (p. 64).
  - c^2. Geographic range, Oregon and California east of Sacramento and San Joaquin Valleys, except Klamath Canyon.
    - d^1. Color dark; interorbital constriction less than 7.6 mm., *Scapanus latimanus sericatus* (p. 71).
    - d^2. Color pale; interorbital constriction more than 7.6 mm.
      - e^1. Greatest length of skull less than 36 mm., *Scapanus latimanus dilatus* (p. 72).
      - e^2. Greatest length of skull more than 36 mm., *Scapanus latimanus alpinus* (p. 75).

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[1] Pm. $\frac{3}{3}$ in the type and only specimen of *Scapanus anthonyi*.

Descriptions of Species and Subspecies of Scapanus.

SCAPANUS TOWNSENDII (Bachman).

TOWNSEND'S MOLE.

(Pl. IV, fig. 1; Pl. V, figs. 1, 1a; Pl. VI, fig. 10.)

Scalops canadensis Richardson, Fauna Boreali-Amer., part 1, p. 9, 1829. (Not of Desmarest or Harlan.)

Scalops Townsendii Bachman, Journ. Acad. Nat. Sci., Philadelphia, vol. 8, part 1, p. 58, 1839.

Scalops Townsendi Bachman, Boston Journ. Nat. Hist., vol. 4, p. 31, January, 1842.

Scapanus Towsendii (sic) Pomel. Archiv. Sci. Physiques et Nat., vol. 9, p. 247, 1848.

Scalops metallescens Cassin, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 242, 1854. (Nomen nudum.)

Scalops æneus Cassin, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 299, 1854. Type locality, Oregon.

[*Talpa*] *ænea* Le Conte, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 327, 1854.

Talpa Townsendii Le Conte, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 327, 1854.

Talpa tæniata Le Conte, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 327, 1854. Type locality, banks of Columbia River.

Sc[*apanus*] *Townsendi* Peters, Monatsber. König. Preuss. Akad. Wissensch., Berlin, 1863, p. 656, 1864.

Scapanus Townsendii True, Proc. U. S. Nat. Mus., vol. 7, p. 607, 1885.

Type locality.—"Banks of the Columbia River." Probably from the vicinity of Fort Vancouver, Clarke County, Washington, which it seems well to consider the type locality.

Type specimen.—Cotype, No. 449, Acad. Nat. Sci. Philadelphia; collected May 9, 1835,[1] by J. K. Townsend.

Geographic range.—Extreme northwestern California, Oregon, and Washington west of the Cascade Mountains.

General characters.—Size largest of the genus; color dark, almost black; skull large, mastoids relatively heavy, rostrum long; unicuspid teeth evenly spaced and not crowded. The young of *S. townsendii* in superficial skin characters often resemble adults of *S. orarius*, but are easily separated from the latter by their large fore feet, with thick, heavy claws.

Color.—*Winter pelage:* Upperparts blackish brown, fuscous-black, sooty black, to almost black, usually with a purplish sheen; underparts very slightly paler than the back and frequently stained with brown. *Summer pelage:* Much like winter pelage, but very slightly paler, with purplish sheen more pronounced.

Skull.—Large (greatest length of smallest skulls more than 40 mm.), flat, and angular; mastoids angular and rather heavy; interparietal relatively narrower antero-posteriorly than in *S. latimanus;* slight but distinct sagittal crest between anterior portions of parietals in adults; zygomata heavy; rostrum long and relatively narrow; sublachrymal-maxillary ridge well developed; dentition heavy; unicuspid teeth, both maxillary and mandibular, evenly spaced and not crowded as in *latimanus;* mandible relatively weaker than in *latimanus.*

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[1] The date is not on the labels now attached to the specimen, but Bachman (loc. cit.) states it was collected May 9, 1835.

Measurements.—Average of 3 young adult females from vicinity of Portland, Oreg.: Total length, 206 (195–222); tail vertebræ, 48.3 (45–51); hind foot, 26.3 (24–28). Average of 7 adult males from Ferndale, Humboldt County, Cal.: 224.1 (217–237); 41.1 (34–50); 26.7 (26–27). Average of 4 adult females from Ferndale, Cal.: 208 (202–210); 41.8 (37–46); 26.8 (26–27). *Skull:* Average of 10 skulls of adult males from Puyallup, Wash.: Greatest length, 43.6 (42.3–44.6); palatilar length, 18.1 (17.4–18.8); mastoidal breadth, 20.8 (20.3–21.4); interorbital breadth, 9.2 (9.1–9.4); maxillary tooth row, 14.1 (13.7–14.4); mandibular molar-premolar row, 13.8 (13.5–14.4). Average of 10 skulls of adult females from Puyallup, Wash.: Greatest length, 42.3 (41.5–44.1); palatilar length, 17.6 (16.9–18.1); mastoidal breadth, 19.9 (19.3–20.4); interorbital breadth, 8.9 (8.4–9.2); maxillary tooth row, 13.9 (13.5–14.4); mandibular molar-premolar row, 13.6 (13.2–14). Average of 3 skulls of young adult females from the vicinity of Portland, Oreg.: Greatest length, 41.8 (41.2–42.1); palatilar length, 17.6 (17.3–18); mastoidal breadth, 19.8 (19.4–20); interorbital breadth, 9 (8.7–9.1); maxillary tooth row, 13.4 (13.3–13.5); mandibular molar-premolar row, 13.2 (13.1–13.3). Average of 7 skulls of adult males from Ferndale, Humboldt County, Cal.: Greatest length, 42.9 (42.3–44.2); palatilar length, 18.3 (17.7–18.7); mastoidal breadth, 20.9 (20–21.8); interorbital breadth, 9 (8.7–9.5); maxillary tooth row, 13.9 (13.5–14.2); mandibular molar-premolar row, 13.7 (13.2–14.1). Average of 4 skulls of adult females from Ferndale, Cal.: Greatest length, 41.5 (41.2–41.9); palatilar length, 17.9 (17.8–18); mastoidal breadth, 20 (19.9–20.2); interorbital breadth, 8.9 (8.7–9.1); maxillary tooth row, 13.7 (13.5–13.9); mandibular molar-premolar row, 13.3 (13.2–13.5).

Remarks.—The presence of moles in the Pacific northwest was known to some of the early explorers, but the first one described was by Richardson,[1] who, though very accurately describing the animal now known as *Scapanus townsendii,* referred his specimens to the common mole of eastern United States, then known as *Scalops canadensis* Desmarest. It was not until ten years later that the species was named, when Bachman[2] published his description based upon two specimens. One specimen was a normally colored individual received from Nuttall from a locality not stated; the other was collected by Townsend and according to Bachman (loc. cit.) was labeled "Banks of the Columbia River, May 9, 1835." The latter specimen is a partial albino, having a narrow, irregular white streak extending from chin to abdomen, and another from forehead to snout; this specimen (No. 449) is now in the Academy of Natural Sciences of Philadelphia, where sometime in later years it was marked "Type of *Scalops townsendii.*" It is not the type, since Bachman's description was based in part if not primarily on the specimen submitted by Nuttall; it may well be considered a cotype, however, since Bachman does not designate a type; that he considered the two specimens one and the same species is evident in his remark: "I subsequently received from Mr. Townsend another specimen, a little larger in size, which I presume to be a mere variety, although very singularly marked" (loc. cit., p. 58). This same abnormal specimen became, in 1854, the type of *Talpa tæniata* Le Conte. Cassin exhibited and described a mole which he called "*Scalops metallescens*" before the Philadelphia Academy in 1853, but in the published account[1] of his talk and exhibition, which appeared the next year, the name "*Scalops metallescens*" occurs without any description. Subsequently, however, Cassin[2] described the animal under the name "*Scalops æneus;*" the type[3] is now in the United States National Museum. Cassin states: "In its dentition and otherwise it is a strict congener of *Scalops townsendii*, but is much smaller and of a different color. Its black claws are especially remarkable, and distinguish it from all other species of the genus" (loc. cit.). Unfortunately the skull has been lost, but the skin seems to show that it is of a rather young specimen of *Scapanus townsendii* which has been shrunk and discolored by some chemical, possibly corrosive sublimate. The general tone of color of the back is between Brussels brown and Prout's brown; the underparts are mostly buckthorn brown, and on chin and ankles is a suspicious tinge of sulphine yellow. The claws are heavy as in *townsendii* and do not indicate specific relationship with *S. orarius;* both claws and soles of the feet are black, which might readily be accounted for by the presence of mercuric sulphid from the combination of carbon bisulphid and corrosive sublimate used in preserving specimens.

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[1] Richardson, J., Fauna Boreali-Amer., part 1, pp. 9–12, 1829.

[2] Bachman, J., Journ. Acad. Nat. Sci. Philadelphia, vol. 8, part 1, pp. 58–60, 1839.

Townsend's mole, though showing considerable individual variation in size and in proportions and shape of skull, is subject to very little geographic variation. In a large series of skulls from Puyallup, Wash., are four which have supernumerary premolars. Three of these have each an extra premolar between the second and third premolars of the right mandible; the other specimen has a supernumerary tooth between the second and third premolars of the left mandible, and a minute extra tooth between the third and fourth right lower premolars. This is interesting since *Scapanus* normally has the theoretically complete mammalian dentition of 44 teeth.

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[1] Cassin, J., Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 242, 1854.

[2] Cassin, loc. cit., p. 299, 1854.

[3] No. 3725 ,U. S. Nat. Mus., skin without skull; collected in Oregon, by "U. S. Exploring Expedition."

Specimens examined.—Total number, 203, as follows:

California: Cresent City, 6; Ferndale, 11;[1] Smith River, 2.

Oregon: Beaverton, 3; Coquille, 1; Drain, 1; Goldbeach, 2; Grants Pass, 1; Netarts, 1;[2] Oregon City, 3; Portland, 24;[2, 3, 4] Salem, 3; Seaton, 1; "U. S. Exploring Expedition," 1; Wells, 1.

Washington: Columbia River (type locality), 1;[5] Hot Springs Trail, Olympic Mountains, 1;[6] Lake Cushman, 2; La Push, 1; Puyallup, 108;[7] Renton, 1;[1] Roy, 1; Sauk, 1; Seattle, 1; Skykomish, 1; South Bend, 5; Steilacoom, 3; Tacoma, 1;[5] Tenino, 3; Vancouver, 11; Vancouver Barracks (probably exact type locality), 1.

SCAPANUS ORARIUS ORARIUS True.

COAST MOLE.

(Pl. IV, fig. 2; Pl. V, figs. 2, 2a; Pl. VI, fig. 11.)

Scapanus orarius True, Proc. U. S. Nat. Mus., vol. 19, p. 52, December 21, 1896.

Type locality.—Shoalwater Bay, Pacific County, Washington.

Type specimen.—No. $\frac{1381}{37434}$, U. S. Nat. Mus.; ♀ young adult, skin and skull (posterior portion of braincase broken and incomplete); collected August 30, 1855, by J. G. Cooper.

Geographic range.—Humid coast region of northern California (north of Mendocino), Oregon, and Washington.

General characters.—Size medium; color dark. The subspecies *orarius* is somewhat smaller than *S. l. latimanus*, with relatively smaller fore feet, and slenderer claws; darker than *latimanus*. Similar in color to *S. townsendii*, but very much smaller, with actually and relatively smaller feet and claws. The skull of *S. o. orarius* can always be easily distinguished from that of *townsendii* by its much smaller size, without reference to any other characters; from that of *latimanus* it differs in its evenly spaced and uncrowded unicuspid teeth, its very narrow rostrum, undeveloped and indistinct sublachrymal-maxillary ridge, and very weak mandible; teeth, particularly the first incisors, smaller than in *latimanus*.

Color.—General tone much the same as in *S. townsendii*. *Winter pelage:* Upperparts fuscous-black, chætura black, blackish brown, to nearly black; underparts slightly paler and more grayish. *Summer pelage:* Much like winter pelage but usually more brownish.

Skull.—Size medium (average greatest length of skulls of adult males about 34 to 35 mm.); mastoid region weak; sublachrymal-maxillary ridge only slightly developed; rostrum very narrow;

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[1] Collection Mus. Vert. Zool., Univ. California.

[2] Collection Oregon State Game Comm.

[3] Collection of H. E. Anthony, New York City.

[4] Collection of S. G. Jewett, Portland, Oreg.

[5] Collection Acad. Nat. Sci. Philadelphia.

[6] Collection Field Mus. Nat. Hist.

[7] One hundred, skulls only; two skeletons.

horizontal ramus of mandible narrow and weak; teeth, especially first incisors, small.

Measurements.—Average of 3 adult males from Eureka, Humboldt County, Cal.: Total length, 167 (163–175); tail vertebræ, 33.7 (31–35); hind foot, 20.7 (20–22). *Skull:* Average of 2 skulls of adult males from Ferndale, Humboldt County, Cal.: Greatest length, 34.3 (33.5–35); palatilar length, 13.5 (13.3–13.7); mastoidal breadth, 16.4 (16.3–16.4); interorbital breadth, 8.1 (8–8.1); maxillary tooth row, 10.7 (10.5–10.9); mandibular molar-premolar row, 10.4 (10.3–10.5).

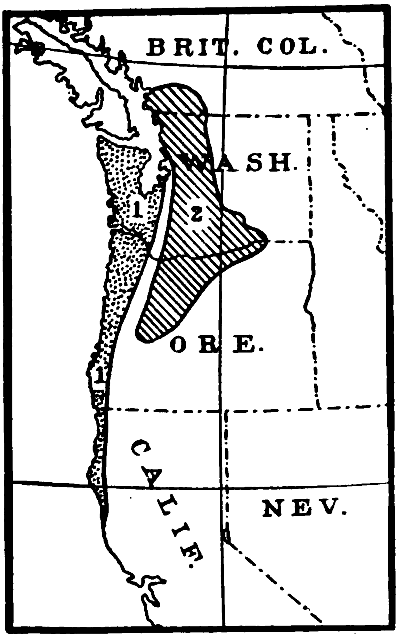

FIG. 12.—Geographic range of the subspecies of *Scapanus orarius*.
1. *S. o. orarius*. 2. *S. o. schefferi*.

Remarks.—Judged by the specimens examined, *Scapanus orarius* (including the subspecies *schefferi*) has a more extensive geographic range than *S. townsendii;* it occurs both farther north and farther south, as well as much farther east (fig. 12). The ecological relationship of the two forms is unknown; its solution would involve most valuable and interesting research for some student favorably situated.

The few specimens of *S. o. orarius* available from the region of the type locality are mostly of young animals or have imperfect skulls. However, there seems to be very little geographic variation, either chromatic or cranial, in specimens taken throughout the whole coastal strip extending from Juan de Fuca to Mendocino County, Cal.

Specimens examined.—Total number, 46, as follows:

California: Crescent City, 3; Cuddeback, 1;[1] Eureka, 6;[1] Ferndale, 2;[1] Mendocino, 1;[2] Orick, 1; Smith River, 1.

Oregon: Astoria, 1;[3] Myrtle Point, 1; Newport, 1; Portland, 3;[4] Yaquina Bay, 4.

Washington: Chehalis County, 1; King County, 1;[5] La Push, 1; Neah Bay, 2; Pacific County, 1;[6] Port Townsend, 1; Puyallup, 6; Shoalwater Bay (type locality), 2; South Bend, 5; Steilacoom, 1.

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[1] Collection Mus. Vert. Zool., Univ. California.

[2] Collection Field Mus. Nat. Hist.

[3] Collection Univ. Michigan Mus.

[4] Collection of H. E. Anthony, New York City.

[5] Collection Milwaukee Public Mus.

[6] Collection Amer. Mus. Nat. Hist.

SCAPANUS ORARIUS SCHEFFERI subsp. nov.[1]

SCHEFFER'S MOLE.

(Pl. IV, fig. 3; Pl. VI, fig. 12.)

Type locality.—Walla Walla, Walla Walla County, Washington.

Type specimen.—No. 204997, U. S. Nat. Mus., Biological Survey collection; ♂ adult, skin and skull; collected August 8, 1914, by Theodore H. Scheffer.

Geographic range.—Extreme southwestern British Columbia, northwestern Washington (east of Puget Sound and north of latitude 48° N.), central and southern Washington from the west slopes of the Cascade Mountains east to Walla Walla, and both slopes of the Cascade Mountains in northern and east-central Oregon.

General characters.—Similar to *S. o. orarius* but much paler, slightly larger, with both hind and fore feet relatively larger, and claws heavier. Skull about the size of that of *orarius*, with relatively shorter and broader rostrum and greater interorbital breadth.

Color.—*Fresh autumn pelage:* Upperparts glossy deep mouse gray; underparts slightly paler and more grayish. *Worn summer pelage:* Upperparts hair-brown to pale fuscous; underparts mouse gray.

Skull.—Compared with that of *S. o. orarius*, the skull of *schefferi* is broader interorbitally and has a relatively and actually shorter and broader rostrum, more evident sublachrymal-maxillary ridge, heavier mandible, and heavier dentition.

Measurements.—Type (adult male): Total length, 170; tail vertebræ, 35; hind foot, 23. Average of 3 adult males (including type) from type locality: 168.7 (165–171); 34.7 (34–35); 23 (23–23). *Skull:* Type (adult male): Greatest length, 34.7; palatilar length, 14.6; mastoidal breadth, 16.7; interorbital breadth, 8.4; maxillary tooth row, 11.2; mandibular molar-premolar row, 10.9. Average of 3 skulls of adult males (including type) from the type locality: Greatest length, 34.4 (34.2–34.7); palatilar length, 14.4 (14.2–14.6); mastoidal breadth, 16.4 (16.2–16.7); interorbital breadth, 8.3 (8.2–8.4); maxillary tooth row, 11.1 (11–11.2); mandibular molar-premolar row, 10.8 (10.8–10.9). Average of 2 skulls of adult females from the type locality: Greatest length, 32.9 (32.8–39); palatilar length, 13.7 (13.6–13.8); mastoidal breadth, 15.9 (15.8–15.9); interorbital breadth, 8.2 (8.2–8.2); maxillary tooth row, 10.6 (10.6–10.6); mandibular molar-premolar row, 10.4 (10.3–10.5).

Remarks.—Typical specimens of *schefferi* are easily distinguishable from *S. o. orarius*, its most closely allied form. The type specimen has fresh autumn pelage on the upperparts, the underparts still retaining the worn summer pelage. On the face of the type specimen is a small spot of ochraceous-buff and a faint wash of the same color on the throat. Similar chromatic abnormalities crop out in several specimens from the type locality, and one specimen (No. 204998, U. S. Nat. Mus.) has as a dental abnormality a supernumerary left upper premolar.

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[1] Named for Theodore H. Scheffer in recognition of his careful investigations of the habits and ecology of American moles.

Intergradation of this form with *orarius* is clearly indicated in specimens from the west slope of the Cascade Mountains in Oregon and Washington. Specimens from Vida, McKenzie Bridge, and Three Sisters, in Oregon, approach *orarius* in color and in cranial characters, though distinctly referable to *schefferi*. Specimens from Mount Vernon, Wash., are slightly darker in color than specimens from Walla Walla, but the skulls are almost identical in essential characters with the type series. Specimens from Skykomish, Wash., are nearly as dark as typical *orarius*, but are referred to *schefferi* because of cranial characters which, although approaching *orarius*, are much nearer *schefferi*.

Specimens examined.—Total number, 59, as follows:

British Columbia: Chilliwack Valley, 2; Chiloweyuck Depot, 2; Fraser River (near New Westminster), 1;[1] Sumas, 6.

Oregon: McKenzie Bridge, 2; Three Sisters, 2; Vida, 4.

Washington: Easton, 4; Fort Walla Walla, 4; Lester, 4; Merritt, 5; Mount Vernon, 2; North Yakima, 5; Skykomish, 6; Walla Walla (type locality), 5; Wenatchee, 5.

SCAPANUS LATIMANUS LATIMANUS (Bachman).

California Mole.

(Pl. IV, fig. 4; Pl. V, figs. 3, 3a; Pl. VI, fig. 13.)

Scalops latimanus Bachman, Boston Journ. Nat. Hist., vol. 4, p. 34, 1842.

Scalops californicus Ayres, Proc. California Acad. Sci., vol. 1, p. 54, 1856. Type locality, San Francisco, California.

Scapanus californicus True, Proc. U. S. Nat. Mus., vol. 19, p. 52, December 21, 1896.

Scapanus latimanus Osgood, Proc. Biol. Soc. Washington, vol. 20, p. 52, April 18, 1907.

Scapanus latimanus latimanus Miller, U. S. Nat. Mus., Bul. 79, p. 9, December 31, 1912.

Type locality.—Probably Santa Clara, Santa Clara County, California.[2]

Type specimen.—Mounted specimen, with imperfect skull, in the Berlin Museum; collected during October, 1834.

Geographic range.—Western California west of the San Jacinto and Sacramento Valleys, from Santa Maria River north to Cape Mendocino, thence northeasterly to Klamath Canyon, Siskiyou County.

General characters.—Size medium (length of adults usually about 170 to 180 mm.); color fuscous or drab to chætura black, most frequently chætura drab; skull flat, rather massive in the maxillary region; rostrum short and relatively heavy; unicuspid teeth irregular and crowded.

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[1] Collection Amer. Mus. Nat. Hist.

[2] Vide Osgood, W. H., Proc. Biol. Soc. Washington, vol. 20, p. 52, 1907.

Color.—Fresh winter pelage: Above, fuscous-black, chætura drab, or chætura black; old and faded specimens more brownish, fuscous to mummy brown; beneath, much as above but paler, usually slightly more grayish, and frequently stained with brown mid-ventrally. *Summer pelage:* Usually paler and slightly more brownish than winter pelage, drab, hair-brown, or chætura drab, paler beneath. *Young:* Usually darker and more grayish than adults.

Skull.—Size medium, flat; sublachrymal-maxillary ridge heavy and well defined; rostrum short and broad; unicuspid teeth irregular in size, and crowded; second lower incisor caninelike, larger, and longer than either the first or the third incisor. The skull of *S. l. latimanus* is very much smaller than that of *S. townsendii*, the skulls of large adult males of *latimanus* being smaller than the skulls of small adult females of *townsendii;* the rostrum of *latimanus* is relatively shorter and broader than that of *townsendii*, and the unicuspid teeth are more irregular in size and shape, and more crowded. Compared with *S. o. orarius* the skull of *latimanus* is wider and much heavier, with less rounded and more truncate braincase, much shorter and broader rostrum, much heavier sublachrymal-maxillary ridges, larger teeth, and heavier horizontal rami of mandibles. The skull of typical *latimanus* is larger than that of any other subspecies of *S. latimanus* except *S. l. alpinus*, from which it is indistinguishable.

Measurements.—Adult male from Gilroy, Santa Clara County, Cal.: Total length, 173; tail vertebræ, 35; hind foot, 23. Average of 4 young adult males from Santa Cruz, Cal.: 175.8 (173–181); 33.3 (32–38); 20.8 (20–21). Average of 4 young adult females from Santa Cruz, Cal.: 171.5 (162–185); 32.5 (31–35); 20.8 (20–21). *Skull:* Adult male from Gilroy, Santa Clara County, Cal.: Greatest length, 36.2; palatilar length, 14.4; mastoidal breadth, 17.3; interorbital breadth, 7.8; maxillary tooth row, 11.2; mandibular molar-premolar row, 10.9. Average of 4 skulls of young adult males from Santa Cruz, Cal.: Greatest length, 36.1 (35.7–36.6); palatilar length, 14.2 (13.8–14.6); mastoidal breadth, 17 (16.9–17.3); interorbital breadth, 7.8 (7.5–8); maxillary tooth row, 11 (10.8–11.1); mandibular molar-premolar row, 10.6 (10.5–10.8). Average of 7 skulls of adult males from Nicasio, Cal.: Greatest length, 37.1 (36.6–37.4); palatilar length, 14.5 (14.3–14.7); mastoidal breadth, 17.3 (17–17.8); interorbital breadth, 7.8 (7.5–7.9); maxillary tooth row, 11.3 (11.1–11.6); mandibular molar-premolar row, 11 (10.7–11.4). Average of 4 skulls of young adult females from Santa Cruz, Cal.: Greatest length, 34.7 (34.4–35); palatilar length, 13.8 (13.4–14.1); mastoidal breadth, 16.8 (16.6–17); interorbital breadth, 7.8 (7.7–8); maxillary tooth row, 10.7 (10.4–10.9); mandibular molar-premolar row, 10.3 (10.1–10.5). Average of 5 skulls of adult females from Nicasio, Cal.: Greatest length, 36 (35.3–36.6); palatilar length, 14.1 (13.7–14.5); mastoidal breadth, 16.9 (16.7–17.2); interorbital breadth, 7.7 (7.4–8.1); maxillary tooth row, 11.1 (10.8–11.4); mandibular molar-premolar row, 10.8 (10.3–11.1).

Remarks.—Bachman's name *latimanus* was placed in synonymy under *Scapanus townsendii* by Peters[1] where it remained until Osgood showed that it did not apply to *townsendii* but to the mole of west-central California, then known as *Scapanus californicus* (Ayres). Osgood writes:

> As stated by Peters (loc. cit.), it [the type specimen] was transmitted by Deppe from Monterey, California. It was collected in October, 1834, at Santa Clara, not a Mexican locality,[2] as suggested by Peters, but doubtless the town of that name in California not very distant from Monterey. Only one species of mole is known to occur at this locality, and the specimen is typical of this species. The hind foot to end of claws measures 18.7 mm. The fragmentary skull, which Dr. Matschie caused to be removed from the mounted specimen, presents the following measurements, all decidedly smaller than *S. townsendi:* Length of upper tooth row from front of incisor to back of last molar, 15.4; of lower tooth row, 13.7; outside width at second upper molar, 10.2.[3]

The measurements given by Osgood are somewhat less than those of skulls of adults from the vicinity of Santa Clara, Cal., but this may possibly be due to immaturity of the type specimen. The animal is certainly not *townsendii*, and it seems best to accept Osgood's verdict and place *californicus* in synonymy under *latimanus*.

A skeleton[4] of this species in the United States National Museum has been set aside as the type of *Scalops californicus* Ayres, and of it Lyon and Osgood state: "This skeleton is one of Dr. Ayres's original specimens, and probably the only one of them now in existence. It seems well to treat it as a type, although it was not so indicated by the original describer."[5] However, there seems to be no good reason for designating this specimen as the type of *californicus;* it was entered in the museum catalogue February 14, 1857, but in the collection are two other specimens (alcoholic) which Lyon and Osgood apparently overlooked. One[6] of these, without the date of collection, was entered in the catalogue May 4, 1857; the other,[7] collected several weeks after Ayres had read his description before the California Academy of Sciences, was entered in the museum catalogue

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[1] Peters, W., Monatsber. Konig. Preuss. Akad. Wissensch., Berlin, 1863, p. 656, 1864.

[2] At the time the specimen was collected California was part of Mexico. Peters, however, states "in Sta. Clara (Sonora?) gesammelt worden."

[3] Osgood, W. H., Proc. Biol. Soc. Washington, vol. 20, p. 52, 1907.

[4] No. 3111, U. S. Nat. Mus., skeleton (lacking right manus and forearm, and left last upper molar); collected at San Francisco, Cal., by Dr. W. O. Ayres.

[5] Lyon, M. W., and Osgood, W. H., U. S. Nat. Mus., Bul. 62, p. 234, 1909.

[6] No. 2673, U. S. Nat. Mus., alcoholic; collected at San Francisco, Cal., by Dr. W. O. Ayres.

[7] No. 1288, U. S. Nat. Mus., alcoholic; collected at San Francisco, Cal., September, 1855, by Dr. W. O. Ayres.

February 4, 1856. Nothing in the original description would indicate that Ayres had any one particular specimen in mind; in the only place in his description where specimens are mentioned, he refers to the "color of fur, in the specimens seen."[1] Furthermore if Ayres set aside any specimen as the type it was probably in the Museum of the California Academy of Sciences, since preceding his original description the donation of five moles to the Academy was acknowledged and the following statement made concerning them: "In connection with these, Dr. Ayres presented the following description" (loc. cit.). It seems, therefore, that the specimens in the United States National Museum are not a part of Ayres's original series.

Slight local variations in size and shape of skull of *latimanus* might be worthy of subspecific recognition were they constant over any considerable geographic area. However, they are so slight and inconstant, and crop out so frequently, that to recognize them by subspecific appellation would only be confusing, and add nothing to the knowledge of the relationships of the group. Specimens from the coast region north of San Francisco Bay seem to average slightly larger and darker than typical specimens, but the difference is not sufficiently pronounced to warrant subspecific designation. Specimens examined from Klamath Canyon show little approach in color toward *S. l. dilatus*, but the skulls are shorter than in typical *latimanus*, showing in this respect intergradation with *dilatus*. Specimens from Lower Lake and Mount Sanhedrin are paler than typical *latimanus*, probably indicating an approach toward *dilatus*. Intergradation with *S. l. occultus* occurs in the region between Santa Margarita, in San Luis Obispo County, and Santa Barbara; a specimen from the former locality is clearly intermediate, but appears to be nearer *latimanus*.

Specimens examined.—Total number, 171, as follows:

California: Aptos, 1; Bells Station, 1; Berkeley, 8; Berryessa, 1; Beswick, 2; Bodega, 1; Bolinas, 1;[2] Boulder Creek, 1; Brentwood, 1; Briceland, 1; Cahto, 2; Carmel Point, 1;[3] Cazadero, 1; Colma, 1; Cuddeback, 2;[2] Eldridge, 7; Fort Bragg, 2; Freestone, 3;[2] Gilroy, 1; Gualala, 1; Guerneville, 3;[2] Haywards, 5; Hornbrook, 1; Inverness, 1; King City, 1; La Honda, 3;[2,3] Lower Lake 2;[4] Marin County, 1; Mendocino, 3;[2,5] Menlo Park, 8;[2] Monterey, 1;[4] Mount Sanhedrin, 1;[2] Napa, 1;[3] Nicasio, 54; Oakland, 4;[6] Pacific Grove, 1; Palo Alto, 1;[4] Petaluma, 2; Petrolia, 2; Piedmont, 1;[2] Point Arena, 1;[2] Point Reyes, 1; Red Bluff, 2;[3] Rockport, 2; San Francisco, 10; San Leandro, 3;[2] Santa Cruz, 9; Santa Margarita, 1;[2] Santa Rosa, 1;[6] Scott River, Siskiyou County, 1;[2] Snow Mountain, Colusa County, 1;[4] Stanford University, 1;[2] Stevens Creek, San Mateo County, 1;[5] Walnut Creek, Contra Costa County, 2.[2]

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[1] Ayres, W. O., Proc. California Acad. Sci., vol. 1, p. 54, 1856.

[2] Collection Mus. Vert. Zool., Univ. California.

[3] Collection Amer. Mus. Nat. Hist.

[4] Collection Mus. Comp. Zool., Harvard College.

[5] Collection Field Mus. Nat. Hist.

[6] Collection Milwaukee Public Mus.

SCAPANUS LATIMANUS OCCULTUS Grinnell & Swarth.

SOUTHERN CALIFORNIA MOLE.

(Pl. IV, fig. 5; Pl. VI, fig. 14.)

Scapanus latimanus occultus Grinnell & Swarth, Univ. California Publ. Zool., vol. 10, p. 131, April 13, 1912.

Type locality.—Santa Ana Canyon, west slope of north end of Santa Ana Mountains, Orange County, California; altitude 400 feet.

Type specimen.—No. 2369, Mus. Vert. Zool., Univ. California; ♀ young adult, skin and skull; collected September 20, 1908, by H. S. Swarth.

Geographic range.—Southern California west of the deserts, from Olancha, at the south end of Owens Lake, in Inyo County; Sanger, in Fresno County; and Santa Barbara, in Santa Barbara County, south to the San Diegan region.

General characters.—Size small (length of adults usually about 145 to 160 mm.); color in winter pelage paler and slightly more brownish than that of *S. l. latimanus;* color in summer pelage much like that of *latimanus*; skull small, weak; rostrum usually relatively longer and narrower than that of *latimanus.*

Color.—*Winter pelage:* In most specimens paler and more brownish than corresponding pelage of *S. l. latimanus;* upperparts chætura drab or fuscous, and occasionally, in much faded specimens, olive-brown or mummy brown; underparts somewhat paler and more grayish. *Summer pelage:* Very slightly paler than winter pelage; essentially like summer pelage of *latimanus.*

Skull.—Very similar to that of *S. l. latimanus* in general shape and proportions, but much smaller, and in most specimens with relatively longer and narrower rostrum.

Measurements.—Average of 13 young adult males from Compton, Los Angeles County, Cal.: Total length, 151.9 (140–165); tail vertebræ, 25.3 (22–29); hind foot (measured, from relaxed foot of dry skin, by the writer), 18.3 (17.5–19.5). Type (young adult female): 150; 33; 18. Two young adult females from Olancha, Owens Lake, Cal.: Total length, 148, 155; tail vertebræ, 30, 36; hind foot, 18, 19. *Skull:* Average of 13 skulls of young adult males from Compton, Los Angeles County, Cal.: Greatest length, 31.6 (30.7–32.8); palatilar length, 12.3 (12.1–12.8); mastoidal breadth, 15.4 (15–16); interorbital breadth, 7.1 (6.9–7.4); maxillary tooth row, 10 (9.7–10.3); mandibular molar-premolar row, 9.5 (9.3–9.9). Average of 4 skulls of adult males from Witch Creek, Cal.: Greatest length, 32.9 (32.6–33.5); palatilar length, 12.9 (12.7–13.2); mastoidal breadth, 15.8 (15.5–16.1); interorbital breadth, 7.3 (7.2–7.5); maxillary tooth row, 10.3 (10.1–10.5); mandibular molar-premolar row, 9.8 (9.6–10). Skull of type (young adult female): Greatest length, 31.5; palatilar length, 12.3; mastoidal breadth, 15.6; interorbital breadth, 7.1; maxillary tooth row, 9.9; manidibular molar-premolar row, 9.4. Skulls of 2 young adult females from Olancha, Cal.: Greatest length, 31, 31.5; palatilar length, 12.2, 12.6; mastoidal breadth, 15.1, 15.6; interorbital breadth, 7.2, 7.3; maxillary tooth row, 9.9, 10; mandibular molar-premolar row, 9.4, 9.6.

Remarks.—The mole of southern California is constant in characters over its entire range. The type of *occultus* is a young adult female; it has abnormal mandibular teeth; the right first lower premolar is absent, and the left first lower premolar is crowded back and inward, close to the second premolar and in the same enlarged socket with it. Specimens from Witch Creek are slightly larger than those from the type region. Toward the northern border of its range the subspecies shows a gradual increase in size until it intergrades with *S. l. latimanus* in the region north of Santa Barbara County. A young adult male from Tehachapi and a specimen from Santa Barbara approach *latimanus* in size. A male from Porterville, Tulare County, is larger and slightly darker than typical specimens of *occultus*, and has a relatively narrower skull, probably showing in these respects a tendency towards *S. l. sericatus*. An imperfect skeleton, with broken skull, from Sanger, Fresno County, is provisionally referred to *occultus;* in dentition and in the size and proportions of the mandible it is indistinguishable from specimens from the type region. Two females from the south end of Owens Lake are almost indistinguishable from typical *occultus*, their only approach toward *S. l. grinnelli* being in slightly higher braincase. The relationships of *occultus* with *Scapanus anthonyi* are not clear, but the differences in size and color alone are sufficient to separate the two forms, even though it should ultimately be proven that the dentition of the type of *anthonyi* is abnormal (p. 76).

Specimens examined.—Total number, 73, as follows:

California: Alhambra, 10; Canyada Laga, 4 miles north of Ventura, 1;[1] Compton, 21; Julian, 2;[2] Los Angeles, 3; Olancha, 2; Pasadena, 2;[2] Porterville, 1; Riverside, 1; San Bernardino, 5; San Bernardino Peak, 1; San Diego County, 5; San Gabriel, 1; Sanger, 1;[2] San Jacinto Mountains, 2;[2] Santa Ana Canyon (type locality), 1;[2] Santa Barbara, 1; Sierra Madre, Los Angeles County, 1;[2] Somerset, 4; Tehachapi, 1; Ventura, 1;[2] Warner Pass, San Diego County, 1;[2] Witch Creek, 5.

SCAPANUS LATIMANUS GRINNELLI Jackson.

GRINNELL'S MOLE.

(Pl. IV, fig. 6; Pl. VI, fig 15.)

Scapanus latimanus grinnelli Jackson, Proc. Biol. Soc. Washington, vol. 27, p. 56, March 20, 1914.

Type locality.—Independence, Inyo County, California; altitude 3900 feet.

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[1] Collection Milwaukee Public Mus.

[2] Collection Mus. Vert. Zool., Univ. California.

Type specimen.—No. 17785, Mus. Vert. Zool., Univ. California; ♂ adult, skin and skull; collected May 8, 1912, by H. A. Carr.

Geographic range.—Known only from type locality.

General characters.—Size small; very slightly larger than average specimens of *S. l. occultus* or *S. l. minusculus;* smaller than *S. l. sericatus;* color darkest of the *latimanus* group; skull short and high, broad interorbitally and through mastoids; rostrum short and wide.

Color.—Type, in worn and somewhat faded *winter pelage:* Upperparts between fuscous and fuscous-black; underparts more grayish, stained on the throat and chest with Dresden brown. Topotype, in *fresh summer pelage:* Upperparts fuscous-black; underparts dark mouse gray.

Skull.—Short and high, not much depressed postorbitally, broad interorbitally and through the mastoids; posterior base of zygoma with a small inconspicuous process on outer lateral margin; rostrum short and wide; angle of mandible short and heavy. The skull of *grinnelli* is about the size of large skulls of *S. l. occultus*, but differs from them, in its higher braincase, its shorter and much broader rostrum, and in being much wider interorbitally and through the mastoids. It is much smaller and relatively shorter and wider than the skull of either *S. l. latimanus* or *S. l. sericatus.*

Measurements.—Type (adult male): Total length, 156; tail vertebræ, 31; hind foot, 21. Topotype (adult female): Total length, 158; tail vertebræ, 36; hind foot, 20.5 *Skull:* Type (adult male): Greatest length, 33; palatilar length, 13.1; mastoidal breadth, 17; interorbital breadth, 7.8; maxillary tooth row, 10.4; mandibular molar-premolar row, 10. Skull of topotype (adult female): Greatest length, 32.2; palatilar length, 12.8; mastoidal breadth, 16.4; interorbital breadth, 7.8; maxillary tooth row, 10.3; mandibular molar-premolar row, 9.9.

Remarks.—This form is a well-marked subspecies which can be separated from *S. l. occultus* either by skin or skull characters. Intergradation with *occultus* probably occurs in the region north or west of Owens Lake; a very slight indication of such intergradation is noticeable in specimens of *occultus* from Olancha. The topotype is peculiar in that the left upper tooth row contains a supernumerary premolar, apparently the one immediately posterior to the canine and probably derived from the anlage of the first premolar. As is the case in some specimens of *S. townsendii*, previously mentioned, this is especially interesting, since it gives this individual one more tooth than the theoretically complete mammalian dentition of 44 teeth.

Specimens examined.—Two, from type locality.[1]

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[1] Collection Mus. Vert. Zool., Univ. California.

SCAPANUS LATIMANUS SERICATUS Jackson.

YOSEMITE MOLE.

(Pl. IV, fig. 7; Pl. VI, fig. 16.)

Scapanus latimanus sericatus Jackson, Proc. Biol. Soc. Washington, vol. 27, p. 55, March 20, 1914.

Type locality.—Yosemite, Yosemite Valley, Mariposa County, California.

Type specimen.—No. 109548, U. S. Nat. Mus., Biological Survey collection; ♀ adult, skin and skull; collected August 20, 1901, by W. K. Fisher.

Geographic range.—Yosemite region, Mariposa County, Cal.

General characters.—Smaller than *S. l. latimanus*, darker and more grayish in fresh pelage; larger and darker than *S. l. occultus* or *S. l. minusculus;* claws, especially of fore feet, longer and more slender than those of *latimanus;* skull relatively long, narrow, and flat.

Color.—*Fresh summer pelage:* Upperparts fuscous-black; underparts more grayish, dark mouse gray. *Worn summer pelage:* Upperparts glossy olive-brown, underparts slightly paler.

Skull.—Relatively long, narrow, especially through mastoids; smaller than that of *S. l. latimanus;* larger than that of *S. l. occultus*, *S. l. minusculus*, or *S. l. grinnelli;* about equal in length to that of *S. l. dilatus*, but much narrower, and not so high through the braincase.

Measurements.—Two adult females, type and virtual topotype: Total length, 165, 171; tail vertebræ, 36, 34; hind foot, 21, 22. *Skull:* Skulls of two adult females, type and virtual topotype: Greatest length, 34.3, 34; palatilar length, 13.3, 13.7; mastoidal breadth, 16.2, 15.9; interorbital breadth, 7.2, 7.5; maxillary tooth row, 11, 10.8; mandibular molar-premolar row, 10.4, 10.4.

Remarks.—The skulls of the type and topotype[1] of *sericatus* show minor differences, but in essential features they are remarkably alike. They are very unlike the skull of *S. l. minusculus*, being distinctly larger, and with different proportions. The subspecies *sericatus* is intermediate in size between *S. l. latimanus* and *S. l. occultus*, and in fresh pelage is darker than either. The type of *sericatus* is mostly in worn summer pelage, fresh pelage appearing on the abdomen and flanks; the topotype is in fresh summer pelage. An adult male from Bower Cave, Mariposa County, is not typical of the subspecies; it has a shorter tail than specimens from the Yosemite Valley, and the skull is flatter and wider through the braincase than that of typical *sericatus*.

Specimens examined.—Total number, 3, as follows:

California: Bower Cave, 1; Yosemite (type locality), 1; Yosemite Valley, 1.[2]

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[1] No. 12980, Mus. Vert. Zool., Univ. California.

[2] Collection Mus. Vert. Zool., Univ. California.

SCAPANUS LATIMANUS MINUSCULUS Bangs.

SIERRA MOLE.

(Pl. IV, fig. 8; Pl. VI, fig. 17.)

Scapanus californicus minusculus Bangs, Proc. New England Zool. Club, vol. 1, p. 70, July 31, 1899.

Scapanus latimanus minusculus Miller, U. S. Nat. Mus., Bul. 79, p. 10, December 31, 1912.

Type locality.—Fyffe, El Dorado County, California.

Type specimen.—No. 9189, Mus. Comp. Zool., Harvard College, Bangs collection; ♀ young adult, skin and skull; collected July 15, 1897, by W. W. Price and E. M. Nutting.

Geographic range.—Known only from type locality.

General characters.—Similar in size and color to *S. l. occultus*, possibly very slightly larger; skull higher and narrower through braincase than that of *occultus;* inferior mandibular notch very shallow, the angle of mandible being much shorter than in *occultus.*

Color.—Type, in *summer pelage:* Upperparts hair-brown; underparts deep mouse gray.

Skull.—Much like that of *S. l. occultus*, but braincase narrower, higher, and more rotund; inferior mandibular notch very shallow, much shallower than in *occultus;* angle of mandible short and weak.

Measurements.—Type (young adult female): Total length, 160; tail vertebræ, 31; hind foot, 21. *Skull:* Type (young adult female): Greatest length, 31.9; palatilar length, 12.6; mastoidal breadth, 15.3; interorbital breadth, 7.1; maxillary tooth row, 10; mandibular molar-premolar row, 9.7.

Remarks.—The type and only-known specimen of *minusculus* is a female, barely adult, the status of which can not be determined until more specimens are obtained from the type locality. The essential differences from *S. l. occultus* are in the skull, which is relatively narrower and higher and with the inferior mandibular notch very shallow; the hind foot is longer than that of *occultus.* This form, however, seems to be isolated from *occultus* by the interception of *sericatus.* In color the type of *minusculus* is much like some specimens of *S. l. dilatus.*

Specimen examined.—One, the type.

SCAPANUS LATIMANUS DILATUS True.

KLAMATH MOLE.

(Pl. IV, fig. 9; Pl. VI, fig. 18.)

Scapanus dilatus True, Proc. U. S. Nat. Mus., vol. 17, p. 242, April 26, 1894.

Scapanus truei Merriam, Proc. Biol. Soc. Washington, vol. 11, p. 102, April 26, 1897. Type locality, Lake City, Modoc County, California.

Scapanus truii (sic) Elliot, Field Columb. Mus., publ. 105, zool. series, vol. 6, p. 469, 1905.

Type locality.—Fort Klamath, Klamath County, Oregon.

Type specimen.—No. 186628, U. S. Nat. Mus., Merriam collection; adult, sex unknown, skeleton; collected in 1883 by Charles E. Bendire.

Geographic range.—South-central Oregon and Upper Sonoran and Transition Zones of northeastern California and adjacent parts of Nevada.

General characters.—Similar to *S. l. latimanus*, but much paler and averaging slightly smaller; skull shorter, higher, and more rotund than in *latimanus*.

Color.—*Summer pelage:* Upperparts mouse gray, light drab, or drab, in some specimens becoming more brownish on the nose; underparts neutral gray, mouse gray, or smoke gray, sometimes tinged with light drab and occasionally stained in midventral line with Dresden brown.

Skull.—Smaller than that of *S. l. latimanus* or *S. l. alpinus*, relatively shorter, higher through the braincase, and relatively wider through the mastoids. About equal in length to the skull of *S. l. sericatus*, but relatively much wider and higher through the braincase.

Measurements.—Two adult males from McCloud, Cal.: Total length, 178, 170; tail vertebræ, 36, 42; hind foot, 21, 21. *Skull:* Type (sex unknown): Greatest length, 34.3; palatilar length, 13.6; mastoidal breadth, 16.8; interorbital breadth, 7.8; maxillary tooth row, 10.4;[1] mandibular molar premolar row, 10.3. Skulls of two adult males from McCloud, Cal.: Greatest length, 34.7, 35.2; palatilar length, 13.2, 13.7; mastoidal breadth, 17.3, 17.3; interorbital breadth, 7.8, 7.9; maxillary tooth row, 9.8, 10.3; mandibular molar premolar row, 9.5, 9.5.

Remarks.—True based his description of this form entirely upon the cranial characters of a specimen with abnormal dentition, there being in the type only three maxillary premolars. Later he placed the name in synonymy[2] under *Scapanus californicus* (=*S. l. latimanus*). The skull of the type, however, is relatively shorter and broader than that of typical *latimanus*. Unfortunately the exact color of the mole found at Fort Klamath, Oreg., is not known, there being no skins available from that locality; two alcoholics from the type locality, however, seem to indicate that the animal is pale, like the mole of northeastern California; from a geographic view point this is what one would anticipate; specimens from Ashland and Fremont, Oreg., are pale, like specimens from northeastern California, and those from Ashland have skulls inseparable from the skull of the type of *dilatus*. The type of *Scapanus truei* Merriam, which is now placed in synonymy under *dilatus*, is a rather young adult collected at Lake City, Modoc County, Cal.; in the original description Merriam mentions the following cranial and dental characters:

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[1] Upper tooth formula abnormal: i. 3, c. 1, pm. 3, m. 3.

[2] True, F. W., Proc. U. S. Nat. Mus., vol. 19, p. 52, 1896.

> Skull similar to that of *S. californicus*, but slightly smaller, with narrower palate and decidedly narrower and more slender rostrum. Last upper premolar with a strongly developed, trenchant inner cusp, not present in *californicus*.[1]

The narrowness of the palate and rostrum is probably due in part to immaturity; the skull of a young adult female, which has been removed from an alcoholic specimen[2] from Fort Klamath, has the rostrum as narrow as that of the type of *truei* though it is slightly shorter. The presence of an inner cusp on the last upper premolar is not of diagnostic value. In any large series of *Scapanus* from a single locality this cusplike process may be present in various stages of development in about half the specimens; it appears more frequently in skulls of young individuals and seems to be absorbed with age. In the type of *truei* this accessory cusp has about reached its maximum development, yet in a specimen[3] collected as nearby as Cedarville, Modoc County, there is a barely perceptible trace of a cusp.

Considerable local geographic variations are observed in this form, but to recognize them by subspecific names would only be confusing. With a large series of specimens available from each of many localities it would be possible to learn more of the extent and relationships of these variations. Specimens from the upper Sacramento Valley show intergradation with *S. l. latimanus*, the color darkening and the skulls becoming larger and more elongate. A specimen from Fremont, Oreg., has certain cranial characters which suggest that *dilatus* may possibly intergrade with *S. o. schefferi* in central Oregon.

Specimens examined.—Total number, 44, as follows:

California: Auburn, 1;[4] Baird, 1; Bald Mountain, 1; Cedarville, 1;[5] Chico, 1; Fort Crook, 1; Hayden Hill, 1; Lake City, 1; McCloud, 2; McCloud River, 1;[5] Millford, 2; Mosquito, El Dorado County, 1;[6] Mount Shasta, 1; Nevada City, 1; Parker Creek, Warner Mountains, 1;[5] Plumas County, 1;[7] Prattville, 1; Quincy, 4; Red Point, 1;[4] Round Mountain, Shasta County, 1; Sisson, 6;[5] Susanville, 4;[4] Tower House, Shasta County, 1.[5]

Nevada: Holbrook, 1.

Oregon: Ashland, 3; Fort Klamath (type locality), 3; Fremont, 1.

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[1] Merriam, C. H., Proc. Biol. Soc. Washington, vol. 11, p. 102, 1897.

[2] No. 186027, U. S. Nat. Mus., Merriam collection.

[3] No. 16723, Mus. Vert. Zool., Univ. California.

[4] Collection Stanford Univ.

[5] Collection Mus. Vert. Zool., Univ. California.

[6] Collection Amer. Mus. Nat. Hist.

[7] Collection Carnegie Mus.

SCAPANUS LATIMANUS ALPINUS Merriam,

Mount Mazama Mole.

Scapanus alpinus Merriam, Proc. Biol. Soc. Washington, vol. 11, p. 102, April 26, 1897.

Type locality.—Crater Lake, Mount Mazama, Klamath County, Oregon; altitude about 7000 feet.

Type specimen.—No. 79967, U. S. Nat. Mus., Biological Survey collection; ♂ adult, skin and skull; collected August 18, 1896, by Vernon Bailey.

Geographic range.—Known only from type locality.

General characters.—About the size of large specimens of *S. l. latimanus*, but much paler; hind foot large; indistinguishable in color from *S. l. dilatus*, but larger; skull like that of large specimens of *latimanus*, and much larger, flatter, and relatively longer and narrower than that of *dilatus*.

Color.—*Worn summer pelage* (type): Upperparts mouse gray; underparts (much worn) deep mouse gray; faded unworn pelage on throat and chest with a distinct buffy sheen.

Skull.—Similar to that of *S. l. latimanus;* indistinguishable from skulls of large adult males of *latimanus*.

Measurements.—Type (adult male): Total length, 188; tail vertebræ, 38; hind foot, 24.5 *Skull:* Type (adult male): Greatest length, 36.9; palatilar length, 14.6; mastoidal breadth, 17; interorbital breadth, 7.9; maxillary tooth row, 11.4; mandibular molar-premolar row, 11.3.

Remarks.—The subspecies *alpinus* is a poorly differentiated form having the color of *S. l. dilatus* and the size and skull proportions of large specimens of *S. l. latimanus;* it is not strictly intermediate between these two forms, however, since specimens of *latimanus* from southwest of Klamath Lake do not reach the maximum size. The type is a very old male with much-worn teeth; the skull is flattened by age and the cusps of the teeth are reduced through wear and absorption.

Specimen examined.—One, the type.

SCAPANUS ANTHONYI Allen.

Anthony's Mole.

(Pl. IV, fig. 10; Pl. V, figs. 4, 4a; Pl. VI, fig. 19.)

Scapanus anthonyi Allen, Bul. Amer. Mus. Nat. Hist., vol. 5, p. 200, August 18, 1893.

Type locality.—San Pedro Martir Mountains, Lower California; altitude 7000 feet.

Type specimen.—No. $\frac{6813}{4947}$, Amer. Mus. Nat. Hist.; ♂ adult, skin and skull; collected May 8, 1893, by A. W. Anthony.

Geographic range.—Known only from type locality.

General characters.—Size, smallest of the genus; feet and hands small; in superficial appearance much like *S. l. occultus*, but smaller and darker; skull smaller than that of *occultus*, flatter, and with relatively shorter rostrum; premolars $\frac{3}{3}$.

Color.—Type: Upperparts between fuscous and fuscous-black; underparts hair-brown to fuscous.

Skull.—Smallest of the genus; in general appearance and proportions similar to that of *S. l. occultus*, but smaller, flatter, and with relatively shorter rostrum; each of the parietals of *occultus* has a small posterior projection, extending between the interparietal and the mastoid, which is not present on the parietals of the type of *anthonyi;* premolars, $\frac{3}{3}$.

Measurements.—Type (adult male): Total length, 135; tail vertebræ, 26; hind foot (measured by the writer from relaxed foot of dry skin), 17. *Skull:* Type (adult male): Greatest length, 30.1; palatilar length, 12; mastoidal breadth, 16.2; interorbital breadth, 7; maxillary tooth row, 9.3; mandibular molar-premolar row, 9.

Remarks.—As previous descriptions of the type and only-known specimen of *anthonyi* have been somewhat inaccurate, particular care has been taken in the present description and measurements. Allen[1] gave the breadth of the interorbital constriction as 7.6 mm., an error probably due to inaccurate measuring instruments. Allen (loc. cit.) claimed that the fourth premolar on one side was wanting and on the other was rudimentary; True[2] in a footnote states that he finds "only three premolars on either side," but elsewhere (loc. cit., p. 51) gives the premolar formula as $\frac{3}{4}$. As a matter of fact, the premolar formula is $\frac{3}{3}$; True has correctly indicated this in his sketch (loc. cit., pl. 3, fig. 6) of the mandible. It is not the fourth premolar that is lacking, but either the first or second, probably the first. It seems possible that the dentition of the type is abnormal; however, the reduction of the premolars by one occurs uniformly in each tooth row. It will be impossible to know the exact status of the form until more specimens are available from the region of the type locality. Full specific rank is here given the form because of the absence of evidence showing intergradation with the nearest geographic neighbor, *S. l. occultus*. The type of *anthonyi* is a fully adult male, and if it represents an average specimen of the form, its size and color alone are sufficient characters by which to separate it from *occultus*.

Specimen examined.—One, the type.

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[1] Allen, J. A., Bul. Amer. Mus. Nat. Hist., vol. 5, p. 200, 1893.

[2] True, F. W., Proc. U. S. Nat. Mus., vol. 19, p. 53, 1896.

Genus PARASCALOPS True.

Parascalops True, Proc. U. S. Nat. Mus., vol. 27, p. 242, April 26, 1894.
Parascalops Beddard, Cambridge Nat. Hist., vol. 10, p. 518, 1902.

Type species.—*Scalops breweri* Bachman.

Geographic range.—Southeastern Canada and northeastern United States from southern New Brunswick, southern Quebec, and eastern Ontario, south to northeastern Ohio and southern Pennsylvania, and in the Appalachian Mountains to western North Carolina (fig. 13).

External characters.—Body robust, not much depressed; tail short (relatively longer than in *Scalopus*), round, thick, and fleshy, slightly constricted at base, annulated, densely covered with rather long, coarse hairs (fig. 14). Head conoidal, depressed. Nose developed into a conical snout (shorter than in *Scalopus* or *Scapanus*), with a superior longitudinal median groove extending the anterior half of its length; nostrils lateral, crescentic, with concavities upward (fig. 15). Eyes minute, concealed in fur. Auricular orifices relatively large. Legs short. Feet large, fleshy, sparsely haired above, naked below. Fore feet handlike, the palms as broad as long (fig. 16). Soles of hind feet each with two tubercles and a distinct heel-pad (fig. 17). Toes not webbed. Claws of fore feet broad, flat, and heavy; those of hind feet relatively short and slender. Fur dense, soft, and silky (coarser than in *Scalopus* or *Scapanus*), the hairs nearly equal in length, producing a velvetlike pelage. Mammæ, 8: latero-pectoral, 2–2; latero-abdominal, 1–1; inguinal, 1–1.

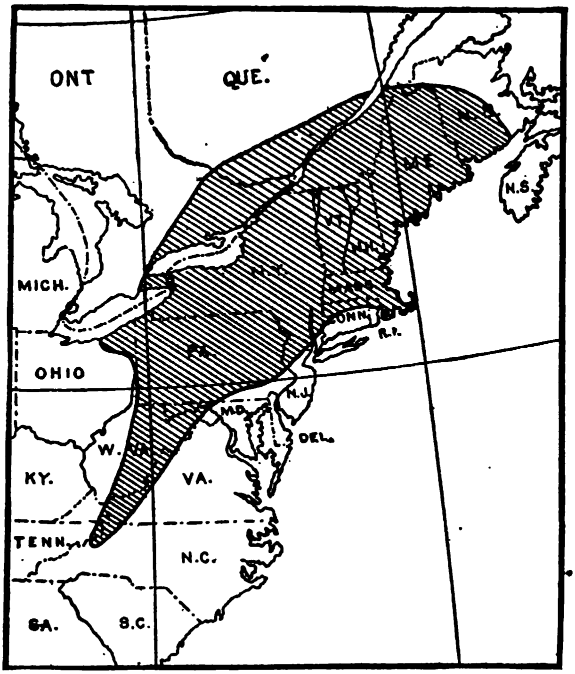

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FIG. 13.—Geographic range of the species *Parascalops breweri.*

Skeletal characters.—Clavicle relatively longer and weaker than in *Scalopus* or *Scapanus*, length about equal to breadth, penetrated antero-posteriorly by a foramen near the inferior border. Humerus heavy, about two-thirds as broad as long. Pelvis narrow, bones of opposite sides not touching under acetabula; no osseous bridges connecting sacral vertebræ with ischium. Superior surface of last sacral vertebra with a small, cuneate, longitudinal process. Os falciforme short, reaching proximal end of first metacarpal; broad and triangular at base, abruptly tapering into a narrow apical process.

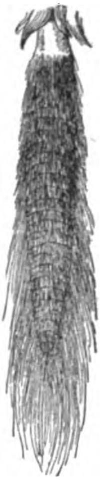

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FIG. 14.—Tail of *Parascalops breweri* (X1½). No. 186618, U. S. Nat. Mus., Merriam collection; from Locust Grove, N. Y.

Skull conoidal (less so than in *Scalopus*), flat (less so than in *Scalopus* or *Scapanus*), somewhat elongate, with moderately broad braincase, slightly constricted interorbitally. Mastoids moderately heavy. Interparietal moderately large (smaller than in *Scapanus*, larger than in *Scalopus*), somewhat rectangular, breadth about one-third the length, emarginate posteriorly and usually anteriorly also, with a posterior median projection. Frontal region depressed; frontal sinuses moderately swollen. Rostrum moderately long; anterior ends of premaxillæ slightly thickened and extending beyond nasals, forming a truncate notch anterior to nasals. Anterior nares opening forward. Zygomata moderately long, relatively heavy, considerably out-curved, the posterior end attached about medially on squamosal. Foramen magnum oval, of moderate size. Infraorbital foramen relatively small (about as in *Scapanus*), the plate forming its outer wall moderately broad (relatively broader than in *Scalopus* or *Scapanus*). Audital bullæ incomplete; no auditory meatus. External pterygoid region moderately inflated (less so than in *Scapanus*) both posteriorly and anteriorly. Mesopterygoid space relatively long and narrow, the sides nearly straight and slightly converging posteriorly. Palate moderately elongate, relatively narrow, terminating opposite posterior edge of last molar; posterior border of palate emarginate, without spine or notch. Anterior palatine foramina moderate (relatively larger than in *Scapanus*), oval; first pair of posterior palatine foramina moderate, oval to elliptical; second pair, minute or obsolete. Horizontal ramus of mandible moderately heavy, curved upward at posterior end and downward at anterior end; coronoid elongate, quadrate, truncate, directed slightly forward; angle of

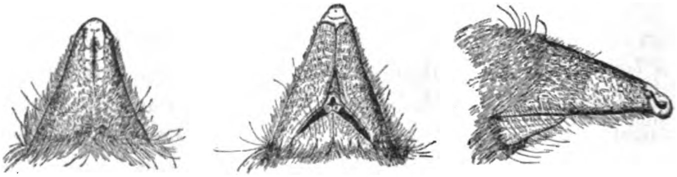

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FIG. 15.—Snout of *P. breweri* (X1½). Individual referred to in fig. 14.

mandible relatively weak (about size of coronoid); inferior mandibular notch broad and shallow.

Dental characters.—First upper incisor short, broad, and flat, with a distinct small external accessory cusp; second and third upper incisors, upper canine, and first, second, and third upper premolars simple, conical, of moderate size, subequal (except canine which is larger), about half as high as first incisor; fourth premolar much larger than third, with anterior cusp, and with narrow interior basal ledge slightly bilobed. Upper molars W-shaped in transverse section, with an internal basal shelf distinctly trilobed in first and second premolars and indistinctly bilobed in the third; second molar slightly smaller than first, the third much smaller than second.

First lower incisor small, simple, slightly flattened; second lower incisor larger than first, conical, somewhat caninelike; third lower incisor small (about size of first), conical. Lower canine, and first, second, and third lower premolars essentially similar to third incisor. Fourth premolar about one-third larger than third, the posterior base with a small cusplike shelf or heel. Lower molars M-shaped in transverse section, both antero- and postero-internal cusps bilobed; first and second molars each with a postero-internal basal accessory cusp; second and third molars each with an antero-internal basal accessory cusp; first and second molars subequal, the third much smaller. Dentition: i. $\frac{3}{3}$; c. $\frac{1}{1}$; pm. $\frac{4}{4}$; m. $\frac{3}{3}$; total 44.

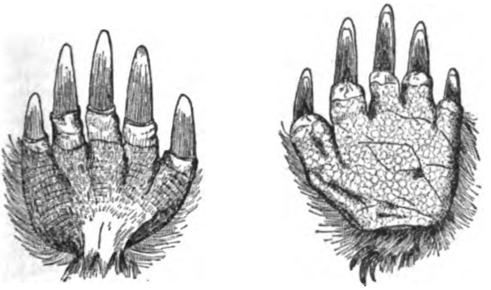

FIG. 16.—Fore foot of *P. breweri* (X1½). Individual referred to in fig. 14.

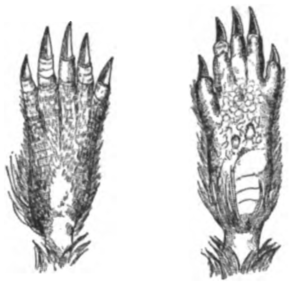

FIG. 17.—Hind foot of *P. breweri* (X1½). Individual referred to in fig. 14.

PARASCALOPS BREWERI (Bachman).

HAIRY-TAILED MOLE.

(Pl. IV, fig. 11; Pl. V, figs. 5, 5a; Pl. VI, fig. 20.)

Talpa Europæa Harlan (nec *Talpa europæa* Linnæus, 1758), Fauna Amer., p. 43, 1825.
Talpa americana Harlan (Bartram ms.) (misidentified with *Talpa europæa* Linnæus, 1758), Fauna Amer., p. 43, 1825.
Scalops Breweri Bachman, Boston Journ. Nat. Hist., vol. 4, p. 32, 1842.

[*Scapanus*] *breweri* Pomel, Archiv. Sci. Physiques et Nat., tome 9, p. 247, 1848.
T[*alpa*] *reposta* Le Conte, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 327, 1854. Type locality unknown.
T[*alpa*] *Breweri* Le Conte, Proc. Acad. Nat. Sci. Philadelphia, vol. 6, 1853, p. 327, 1854.
Scapanus americanus Coues (based erroneously on *Talpa americana* Harlan [Bartram ms.], 1825, qui *Talpa europæa* Linnæus, 1758), Amer. Nat., vol. 13, p. 190, 1879.
Scaphanus (sic) *breweri* Herrick, Geol. & Nat. Hist. Surv. Minnesota, Bul. 7, p. 55, 1892.
Parascalops breweri True, Proc. U. S. Nat. Mus., vol. 17, p. 242, April 26, 1894.

Type locality.—Marthas Vineyard, Massachusetts.

Type specimen.—None known to exist.

Geographic range.—That of the genus (see p. 77).

General characters.—Size medium (length averaging about 155 mm.); nostrils lateral, crescentic, with concavity upward; tail short, thick, densely covered with hair; color dark; usually fuscous-black or chætura black; skull flat; audital bullæ incomplete; rostrum slender; first upper incisors with a distinct external accessory cusp.

Color.—General tone, fuscous-black, chætura black, or chætura drab, slightly paler and more grayish on underparts; hairs on feet, and usually on nose and tail, more brownish, often becoming white in old adults; throat and underparts sometimes stained with Dresden brown or Saccardo's umber. The color in study skins soon fades and becomes slightly brownish.

Skull.—Size medium (length about 32 mm.), flat, depressed postorbitally, especially in adults, slightly constricted interorbitally; zygomata moderately heavy; pterygoids small; audital bullæ incomplete; auditory meatus absent; rostrum narrow; dentition moderate; first upper incisor with distinct outer secondary cusp; internal edge of second upper molar trilobed.

Measurements.—Average of 8 adult males from Magnetic City, N. C.: Total length, 149.5 (139–152); tail vertebræ, 30 (23–36); hind foot, 19.5 (18–20). Average of 2 adult females from Lunenburg, Mass.: 153 (153–153); 29.5 (27–32); 18.5 (18–19). *Skull:* Average of 10 skulls of adult males from Magnetic City, N. C.: Greatest length, 32.4 (31–33.8); palatilar length, 12.6 (12.1–13.1); mastoidal breadth, 14.5 (13.9–15); interorbital breadth, 7.3 (7.1–7.5); maxillary tooth row, 9.9 (9.2–10.2); mandibular molar-premolar row, 9.5 (8.9–9.8). Skull of adult female from Lunenburg, Mass.: Greatest length, 31.2; palatilar length, 12.2; mastoidal breadth, 14.3; interorbital breadth, 7.2; maxillary tooth row, 9.6; mandibular molar-premolar row, 9.3.

Remarks.—Bartram was apparently the first to recognize this form, to which he gave the manuscript name *Talpa americana*. Harlan[1] placed *Talpa americana* (Bartram ms.) in synonymy under *Talpa europæa* Linnæus, apparently failing to distinguish the two forms even with the Bartram manuscript in hand. Bachman[1] described the species in 1842 under the name *Scalops breweri*, basing his description upon a specimen "found by Dr. L. M. Yale, at Martha's Vineyard, an Island on the coast of New England." Coues,[2] however, in 1879 applied the name *Scapanus americanus* to this species on the ground that Harlan's description was "applicable neither to *Scalops* [=*Scalopus*] nor to *Talpa*" and that "he [i. e. Harlan] really had in view an American mole, which he recognized as distinct, both generically and specifically, from our common *Scalops aquaticus*." The name *Talpa americana* Harlan (Bartram ms.), however, is untenable for several reasons: Harlan placed it in synonymy under *Talpa europæa* Linnæus (loc. cit.); Harlan actually misidentified the American animal with *Talpa europæa* Linnæus, as is evident from his mentioning in his introduction a species of mole as common to both continents,[3] and, by process of eliminating those species which he distinctly refers in his descriptions to an American distribution, it becomes evident that the animal he meant was *Talpa europæa* Linnæus; furthermore, Harlan's description, as has been shown by True,[4] is a translation, word for word (with a very few omissions) of Desmarest's[5] description of *Talpa europæa* Linnæus.

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[1] Harlan, R., Fauna Amer., p. 43, 1825.

The description of *Talpa reposta* Le Conte is based upon a specimen from an unknown locality and seems to refer to a specimen of *Parascalops breweri* with slightly abnormal teeth.

The hairy-tailed mole shows remarkably little geographic variation, and such as does occur is obliterated by individual variation. This variation is manifest mostly in size, and, in adults, size variation may reach about 5 per cent below or above the average at a given locality. White spots and blotches on the ventral parts of a few specimens of young, as well as of adults, indicate an occasional tendency toward partial albinism. In extreme old age the skull flattens and becomes much depressed postorbitally. A most peculiar change associated with old age is that, in many specimens examined, the hair on the nose and tail is white; in other specimens, somewhat younger but distinctly adult, some of the hairs on the nose and tail are normally colored, others are white. This peculiar senile variation is not confined to any particular region, but seems to be more prevalent north of Pennsylvania.

The hairy-tailed mole is rather rare and local in distribution, and difficult to trap. It is, therefore, quite probable that in the course of time its known geographic range may be extended considerably.

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[1] Bachman, J., Boston Journ. Nat. Hist., vol. 4, p. 32, 1842.

[2] Coues, E., Amer. Nat., vol. 13, pp. 189–190, 1879.

[3] Harlan, R., Fauna Amer., p. viii, 1825.

[4] True, F. W., Proc. U. S. Nat. Mus., vol. 19, p. 76, 1896.

[5] Desmarest, A. G., Mammalogie, 1re partie, p. 160, 1820.

Bachman[1] lists it from Georgia but does not mention any specimen or definite locality. The writer has seen only three specimens from Canada: One from Quebec, Quebec, is in the United States National Museum; another, a flat skin without skull, was collected at Meaches Lake, Quebec, and is in the Victoria Memorial Museum at Ottawa; the third is a skeleton collected at Saint Catharines, Ontario, and is in the exhibition cases of the United States National Museum. Chamberlain[2] records seeing a specimen from Charlotte County, New Brunswick. Specimens have been collected in Ontario, "near Ottawa,"[3] and at Guelph[4] and Acton.[5] Nash[6] records specimens from several counties in Ontario, but mentions no specific localities.

Specimens examined.—Total number, 129, as follows:

Connecticut: West Winsted, 1.
Maine: Lake Umbagog, 1.
Massachusetts: Harvard, 1;[7] Lunenburg, 3.
New Hampshire: Dublin, 1; Ossipee, 1; Webster, 2.[8]
New York: Elizabethtown, 1;[8] Lake George, 7; Lansing, 3;[9, 10] Locust Grove, 16; Oswego, 1;[10] Plateau Mountain, Catskills, 1; Peterboro, 3; Waterville, 1.
North Carolina: Magnetic City, foot of Roan Mountain, 31; Roan Mountain (altitude 3000 feet), 1.
Ohio: Cleveland, 1; Ellsworth, 2; Ravenna, 3.[10]
Ontario: St. Catherines, 1.
Pennsylvania: Allegheny County, 1; Brownsburg, 1;[11] Carnot, 1;[12] Erie, 1;[10] Leasuresville, 9; New Lexington, 1;[12] Ohiopyle, 1;[12] Pittsburgh, 4;[12] Warren, 1.[12]
Quebec: Meaches Lake, Wright County, 1;[13] Quebec, 1.
Vermont: East Wallingford, 5.[14]
Virginia: Mountain Lake, 1; Mount Rogers, 1.
West Virginia: Cranberry Glades, 1; Franklin, 1; Traveller's Repose, 1; Wetzel County, 1; White Sulphur Springs, 15.[8, 9, 10, 11]

Genus CONDYLURA Illiger.

Condylura Illiger, Prod. Syst. Mamm. et Avium, p. 125, 1811.
Talpasorex Schinz, Cuvier's Thierreich, vol. 1, p. 191, 1821. Nec *Talpasorex* Lesson, 1827.
Astromycter Harris, Amer. Journ. Sci. and Arts, vol. 9, p. 400, June, 1825 (from Machias, Me., "Star" [newspaper]).
Rhinaster Wagler, Nat. Syst. Amphib., p. 14, 1830.
Condytura Todd, Cyclopædia Anat. and Physiol., vol. 2, p. 994, 1839.

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[1] In White, G., Statistics of the State of Georgia, Fauna and Flora, p. 4, 1849.
[2] Chamberlain, M., Bul. Nat. Hist. Soc. New Brunswick, no. 3, p. 39, 1884.
[3] Whiteaves, J. F., Ann. Rept. Dept. Interior Canada for 1888, part 3 (Geol. Surv.), p. 36, 1889.
[4] Goldie, A., Ontario Nat. Sci. Bul., No. 3, p. 40, 1907.
[5] Moore, T. J., Ontario Nat. Sci. Bul., No. 3, p. 41, 1907.
[6] Nash, C. W., Check List of Vertebrates of Ontario, p. 26, 1906.
[7] Collection of Hartley H. T. Jackson.
[8] Collection Mus. Comp. Zool., Harvard College.
[9] Collection Field Mus. Nat. Hist.
[10] Collection Amer. Mus. Nat. Hist.
[11] Collection Acad. Nat. Sci. Philadelphia.
[12] Collection Carnegie Mus.
[13] Collection Victoria Mem. Mus.
[14] Collection of D. E. Kent, Rutland, Vermont.

Astromyctes Gray, List Spec. Mamm. Brit. Mus., p. 76, 1843.
Astromydes Blyth, Cat. Mamm. Asiat. Soc. Mus., p. 87, 1863.
Condylus Van Hyning, Science, n. s., vol. 38, p. 243, August 15, 1913.

Type species.—*Sorex cristatus* Linnæus.

Geographic range.—Southeastern Canada and northeastern United States, from southern Labrador, central Quebec and Ontario, and southeastern Manitoba, south to northeastern Illinois and northern Indiana and Ohio; in the Atlantic coast region south to Virginia (Dismal Swamp) and Georgia (Marlow); and in the Appalachian Mountains to western North Carolina (fig. 18).

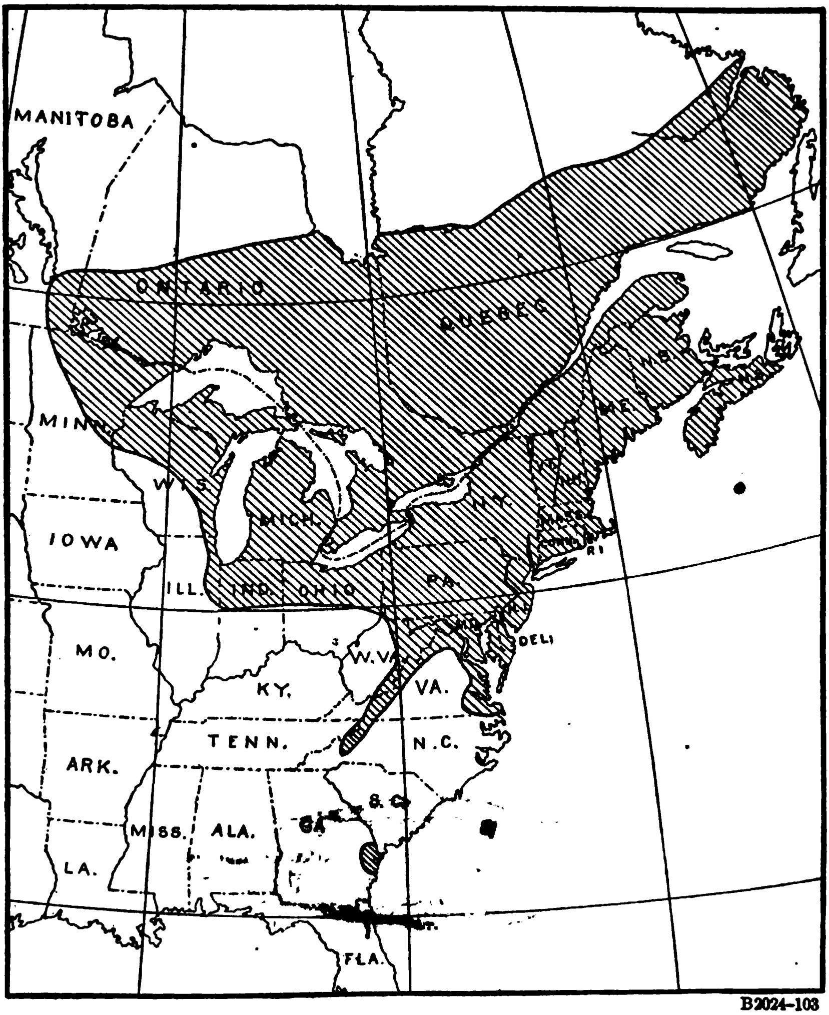

FIG. 18.—Geographic range of the species *Condylura cristata.*

External characters.—Body semirobust, not much depressed. Tail relatively long (about equal in length to body without head), distinctly annulated, scaled, and covered with coarse blackish hairs; in summer the tail is slender, slightly depressed, gradually tapering apically, and slightly constricted proximally; in winter it is greatly enlarged, thick and fleshy, gradually tapering apically, and abruptly much constricted at the base (fig. 19). Head narrow, not much depressed. Snout moderately elongate, terminating in a naked disk surrounded on its margin by a fringe of twenty-two nasal processes symmetrically arranged, eleven on each side of a median line (fig. 20). Nostrils nearly circular, situated in anterior surface of nasal disk. Eyes small (relatively large for Talpidæ; larger than in *Scalopus*, *Scapanus*, or *Parascalops*), concealed in fur. Auricular orifice large. Legs short; weaker than in *Scalopus*, *Scapanus*, or *Parascalops*. Feet large, not especially fleshy, scaled, scarcely haired above, naked below. Fore feet handlike, the palms as broad as long, toes relatively long; first, second, third, and fourth toes each with three flat, triangular processes on outer inferior edge, the basal process on the first toe being small and inconspicuous. Fore claws relatively long, broad (but narrower than in *Scalopus*, *Scapanus*, or *Parascalops*), depressed, the superior surface turned obliquely outward (fig. 21). Hind feet relatively long and narrow, broader apically than basally; a large depressed triangular plantar tubercle lies near the base of the first digit, and distally and inwardly on the sole are five small tubercles. Hind claws relatively long, laterally compressed, the outer surface turned obliquely upward (fig. 22). Toes not webbed. Fur dense, long, and silky (relatively coarser than in *Scalopus*, *Scàpanus*, or *Parascalops*); some of the hairs longer and coarser than the major portion, which forms a distinct underfur. Mammæ, 8: latero-pectoral, 2–2; latero-abdominal, 1–1; inguinal, 1–1.

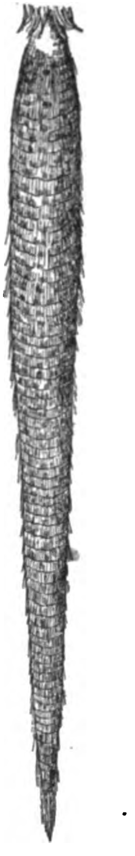

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FIG. 19.—Tail of *Condylura cristata* (× 1½). Autumnal enlargement scarcely begun. No. 144473, U. S. Nat. Mus.; from Egelston township, Muskegon County, Mich., August 20, 1906.

Skeletal characters.—Clavicle relatively long and narrow (for Talpidæ), length about twice the breadth, slightly concave superiorly and convex inferiorly, not penetrated by a foramen. Humerus about two-thirds as broad as long, much weaker medially than in *Parascalops*. Pelvis narrow, bones of opposite sides not touching under acetabula; no osseous bridges connecting sacral vertebræ with ischium. Superior surface of last sacral vertebra with a distinct, flat, deltoid, longitudinal process. Os falciforme small but distinct, short, reaching proximal end of first metacarpal; moderately broad, not much tapering distally.

Skull long and narrow, not much flattened, with relatively high and narrow braincase, not constricted interorbitally, tapering distally. Mastoids weak. Interparietal large, broad, irregularly crescentic, anteriorly deeply emarginate medially, posteriorly broadly emarginate with a posterior median projection. Frontal region sloping ventrally anteriorly; frontal sinuses scarcely swollen. Rostrum long and narrow, in adults with a distinct basal supero-median crest; infero-anterior ends of premaxillæ extending much beyond nasals; supero-anterior ends of premaxillæ barely reaching beyond nasals; nasals in adults terminating anteriorly in an acute median point. Anterior nares opening obliquely upward. Zygomata short, narrow, straight, directed obliquely downward anteriorly, the posterior end well forward on squamosal. Foramen magnum elliptical, large. Infraorbital foramen very large, the plate forming its outer wall relatively very narrow. Audital bullæ incomplete; no auditory meatus. External pterygoid region scarcely inflated. Mesopterygoid space long and broad, the sides converging posteriorly (pterygoids, however, slightly diverging). Palate elongate, very narrow, terminating opposite anterior border of last molar; posterior border of palate deeply emarginate, frequently with a median spine. Anterior palatine foramina minute; posterior palatine foramina very large and conspicuous,

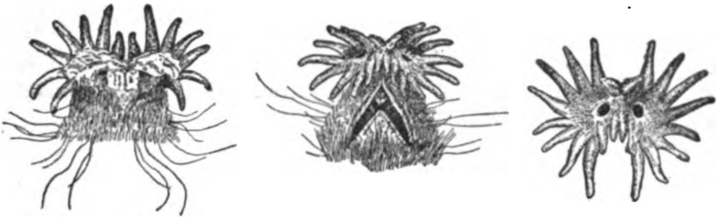

FIG. 20.—Snout of *C. cristata* (× 1½). Individual referred to in fig. 19.

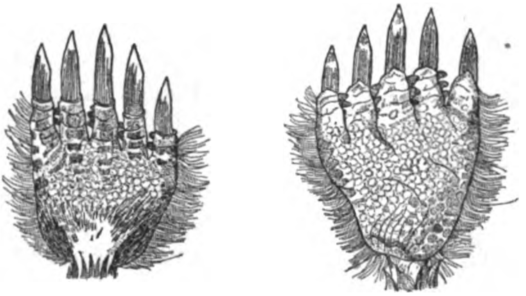

FIG. 21.—Fore foot of *C. cristata* (× 1½). Individual referred to in fig. 19.

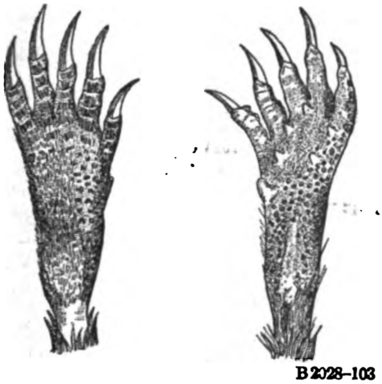

FIG. 22.—Hind foot of *C. cristata* (× 1½). Individual referred to in fig. 19.

the first pair[1] reniform or elliptical-oval and about twice as large as the second pair which are usually elliptical. Horizontal ramus of mandible weak, curved upward posteriorly, straight anteriorly; coronoid moderately long, somewhat broad, but relatively weak, erect, slightly acute; angle of mandible very long and slender (much longer and narrower than coronoid), the inferior edge turned inward; inferior mandibular notch large and angular.

Dental characters.—First upper incisor large, semiovate, curved inward and directed anteriorly; second upper incisor linear, minute, lying close under base of first incisor; third upper incisor lateral, large, elongate, caninelike, with a small postero-basal tubercle disappearing with age. Upper canine short and slender (less than half dimensions of third incisor), conical. First, second, and third upper premolars small, laterally compressed, successively increasing in size posteriorly, each with an anterior and a posterior basal tubercle; fourth upper premolar similar to third, much larger, with an interior basal cusplike process. Upper molars W-shaped in transverse section, with an interior basal shelf having an indistinctly tricuspidate edge; first and second molars nearly subequal, the third much smaller.

First lower incisor moderate in size, spatulate, flat, directed anteriorly; second incisor close and superior to first, similar in shape, much smaller (about half as large), directed anteriorly; third upper incisor minute, slightly flattened apically, curved downward, directed anteriorly. Lower canine long, slender, curved posteriorly, with a rather large posterior basal accessory cusp and a very small anterior one. Lower premolars small (successively slightly increasing in size posteriorly), compressed laterally, each with a well-developed posterior cusplike heel and a small cusplike development (minute in the first premolar) of anterior portion of cingulum. Lower molars M-shaped in transverse section, laterally compressed; interior shelf narrow, tricuspidate, the median cusp indistinctly bifid; first and third molars subequal, the second slightly larger. Dentition: i. $\frac{3}{3}$; c. $\frac{1}{1}$; pm. $\frac{4}{4}$; m. $\frac{3}{3}$; total 44.

CONDYLURA CRISTATA (Linnæus).

STAR-NOSED MOLE.

(Pl. IV, fig. 12; Pl. V, figs. 6, 6a; Pl. VI, fig. 21.)

Sorex cristatus Linnæus, Syst. Nat., ed. 10, vol. 1, p. 53, 1758.

Talpa longicaudata Erxleben, Reg. Anim., p. 118, 1777. Based on Pennant's long-tailed mole; type locality, North America.

Talpa Cristata Zimmermann, Specimen Zool. Geog., p. 496, 1777.

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[1] It may be that these large palatine vacuities are not functional foramina. They have the position, however, of the first pair of posterior palatine foramina, and, whatever their function, they are of considerable generic diagnostic importance.

Talpa Caudata Zimmermann (nec *Talpa caudata* of Linnæus and others), Specimen Zool. Geog., p. 497, 1777. Based on Pennant's long-tailed mole; type locality, North America.

?*Talpa canadensis* De La Faille, Naturgesch. des Maulwurtes, t. 1, p. 3, 1778. [Not seen.]

Talpa radiata Shaw, Gen. Zool., Mamm., vol. 1, p. 523, 1800. New name for *Sorex cristatus* Linnæus.

Sorex radiatus Shaw, Gen. Zool., Mamm., vol. 1, p. 531, 1800. Based upon a figure and description of De La Faille. Type locality, Canada.

Scalopus cristatus Geoffroy, Cat. Mamm. Mus. Nat. Hist. Nat., p. 77, 1803.

Scalops cristatus Fischer, Zoognosia, vol. 3, p. 156, 1814.

Condylura cristata Desmarest, Journ. de Physique, de Chimie, d'Hist. Nat. et des Arts, vol. 89, p. 230, September 1819.

Condylura longicaudata Desmarest, Journ. de Physique, de Chimie, d'Hist. Nat. et des Arts, vol. 89, p: 232, September, 1819.

Tal[pasorex] cristata Schinz, Cuvier's Thierreich, vol. 1, p. 191, 1821.

Condylura fissipes Schinz, Cuvier's Thierreich, vol. 1, p. 191, 1821. (In synonymy.)

Talpa flava Schinz (nec *Talpa flava* Zimmermann), Cuvier's Thierreich, vol. 1, p. 191, 1821. (In synonymy.)

[*Talpa*] *purpurascens* Shinz(nec *Talpa purpurascens* Shaw qui *Talpa europæa* Linnæus), Cuvier's Thierreich, vol. 1, p. 191, 1821. (In synonymy.)

Condylura macroura Harlan, Fauna Amer., p. 39, 1825. Type locality, New Jersey.

Astromycter prasinatus Harris, Amer. Journ. Sci. and Arts, vol. 9, p. 400, June, 1825 (from Machias, Me., "Star" [newspaper]). Type locality, Maine.

Condylura prasinata Harris, Boston Journ. Philos. and Arts, vol. 2, p. 582, July, 1825.

Talpasor[ex] longicaudata Schinz, Cuvier's Thierreich, vol. 4, p. 312, 1825.

?*Talpasorex fissipes* Minding, Geog. Vertheilung der Säugethiere, p. 64, 1829. (Nomen nudum.)

astromycter prarinatus (sic) Rafinesque, Atlantic Journ. and Friend of Knowledge, vol. 1, p. 61, Summer 1832.

Condytura cristata Todd, Cyclopædia Anat. and Physiol., vol. 2, p. 996, 1839.

Rh[inaster] cristatus Wagner, Suppl. Schreber's Säugethiere, vol. 2, p. 114, 1841.

Rh[inaster] macrurus Wagner, Suppl. Schreber's Säugethiere, vol. 2. p. 115, 1841.

Rh[inaster] longicaudatus Wagner, Suppl. Schreber's Säugethiere, vol. 2, p. 115, 1841.

Rh[inaster] macroura Wagner, Suppl. Schreber's Säugethiere, vol. 2, p. 117, 1841.

Talpa (*Condylurus*) *cristata* Blainville, Osteographie, Atlas 1, tables des planches, p. 4; fasc. 6, Insectivores, pl. 1 (skeleton), pl. 5 (skull), pl. 9 (teeth), 1839–1864.

Astromydes (sic) *cristatus* Blyth, Cat. Mamm. Asiat. Soc. Mus., p. 87, 1863.

Condylus (sic) *cristata* Van Hyning, Science, n. s., vol. 38, p. 243, August 15, 1913.

Type locality.—Eastern Pennsylvania.

Geographic range.—That of the genus (see p. 83).

General characters.—Size medium; color dark, blackish; tail long, about equal in length to body (without head), in autumn and winter much enlarged, slightly shortened, but constricted at base, scaly, haired; nostrils anterior, in nasal disk surrounded by twenty-two fleshy processes; skull relatively long and narrow; audital bullæ incomplete; premaxillæ much extended beyond nasals anteriorly; first upper incisors large, incurved, and projecting anteriorly.

Color.—*Fresh pelage:* Upperparts blackish brown to nearly black; underparts paler and more brownish, fuscous to fuscous-black; tail similar to back, sometimes indistinctly bicolored. *Worn pelage:* Paler and more brownish than fresh pelage; upperparts fuscous to fuscous-black; underparts fuscous to hair-brown; wrists frequently with a narrow ring varying from pinkish buff to clay color. Nasal disk and processes in live animals rose color. Young usually paler and more brownish than adults.

Skull.—Size medium (length about 34 mm.), elongate, narrow (breadth across mastoids about 13 mm.), not depressed postorbitally; braincase moderately high and arched; interparietal wide anteroposteriorly; audital bullæ incomplete; premaxillæ much extended beyond nasals anteriorly; adults with distinct crest between posterior halves of nasals; zygomata short, narrow, straight, directed obliquely downward anteriorly; palate narrow; dentition weak; first upper incisor broad, incurved, projecting anteriorly; second upper incisor minute; third upper incisor long, narrow, caninelike, in young with a small postero-lateral basal tubercle; upper molars with indistinctly trilobed inner basal ledge.

Measurements.—Average of 10 adult males from Digby, Nova Scotia: Total length, 202.2 (189–211); tail vertebræ (summer), 78.4 (71–83.5); hind foot, 28.1 (26–30). Average of 2 adult males from Washington, D. C.: Total length, 184 (183–185); tail vertebræ (winter), 65.5 (65–66); hind foot, 28 (28–28). *Skull:* Adult (male ?) from Holmesburg, Pa.: Greatest length, 34.1; palatilar length, 12.9; mastoidal breadth, 13.1; interorbital breadth, 7; maxillary tooth row, 11; mandibular molar-premolar row, 11.3. Average of 3 skulls of adult males from Locust Grove, N. Y.: Greatest length, 34.6 (34.1–35.2); palatilar length, 13.2 (13–13.3); mastoidal breadth, 13.6 (13.5–13.7); interorbital breadth, 7.2 (7.1–7.2); maxillary tooth row, 11.5 (11.4–11.5); mandibular molar-premolar row, 11.6 (11.5–11.7). Skull of adult female from Locust Grove, N. Y.: Greatest length, 35; palatilar length, 13.3; mastoidal breadth, 13.4; interorbital breadth, 7.3; maxillary tooth row, 11.5; mandibular molar-premolar row, 11.9. Average of 10 skulls of adult males from Digby, Nova Scotia: Greatest length, 33.9 (33.1–35); palatilar length, 13 (12.9–13.6); mastoidal breadth, 13.4 (13–14); interorbital breadth, 7.2 (7–7.4); maxillary tooth row, 11.1 (10.6–11.5); mandibular molar-premolar row, 11.3 (11–11.9). Average of 2 skulls of adult males from Washington, D. C.: Greatest length, 33.8 (33.6–33.9); palatilar length, 13.1 (12.7–13.5); mastoidal breadth, 12.7 (12.6–12.8); interorbital breadth, 6.8 (6.7–6.8); maxillary tooth row, 11.2 (11.1–11.2); mandibular molar-premolar row, 11.2 (11.1–11.3).

Remarks.—Linnæus's description, in 1758, of the star-nosed mole under the name *Sorex cristatus*, appears to be its first mention in literature; on the authority of Kalm, Pennsylvania is given as its habitat. Pennant,[1] in 1771, described two moles under the names "Radiated Mole" and "Long-tailed Mole"; the former he correctly considered to be the *Sorex cristatus* of Linnæus; his long-tailed species must also be referred to *Condylura cristata* since he describes it as a mole with a radiated nose and a tail two inches long, a description which applies to no other mammal. Pennant's description of the long-tailed mole was probably based upon either a young or a summer specimen in which the diameter of the tail was minimum; as early as 1777 this became the basis for two Latin binomials, *Talpa caudata* Zimmermann[2] and *Talpa longicaudata* Erxleben.[3] The writer has been unable to verify the name *Talpa canadensis* of De La Faille. Shaw[4] renamed *Sorex cristatus* Linnæus, calling it *Talpa radiata;* he also recognized *Talpa longicaudata,* but in his remarks under *Talpa radiata* states: "It is, perhaps, in reality no other than a variety of the former species (i. e. *T. longicaudata*), or a sexual difference."[5] Shaw[6] again renamed the species when he confused a figure and description of it, given by De La Faille, with the genus *Sorex,* and called it *Sorex radiatus.* That Shaw should thus have been misled is strange, since he writes:

> One would be inclined to think that the remarkable moniliform appearance of the tail in this animal, as exhibited in M. de la Faille's figure, may be partly owing to the contraction of the interstices of the joints in drying.
>
> It is evidently allied to the radiated Mole, but if the figure given by M. de la Faille be accurate, must surely be a very distinct species.[7]

Schinz,[8] when substituting the generic name *Talpasorex* for *Condylura,* used the name *Condylura fissipes* in synonymy under *Talpasorex cristatus;* it seems probable that the name *fissipes* had been used in literature previous to this, but the present writer has been unable to find an earlier usage. Schinz (loc. cit.) also placed the names *Talpa flava* and *Talpa purpurascens* in synonymy under *Talpasorex cristatus;* this was probably purely an error on his part, since there is nothing in the original descriptions of *Talpa flava* Zimmermann and *Talpa purpurascens* Shaw, nor in subsequent descriptions of these forms, which would lead one to confuse either with *Condylura* Illiger; the former name is a synonym of *Scalopus a. aquaticus* (Linnæus), the latter of *Talpa europæa* Linnæus. In 1825, two other names were proposed which apply to the star-nosed mole—

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[1] Pennant, T., Quadrupeds, 1771. The present writer has not seen this work but presumes the descriptions are essentially the same as those in Pennant's History of Quadrupeds, ed. 3, vol. 2, p. 232, pl. 90, 1793.

[2] Zimmermann, E. A. W., Spec. Zool. Geog., p. 497, 1777.

[3] Erxleben, J. C. P., Syst. Reg. Anim., p. 118, 1777.

[4] Shaw, George, Gen. Zool., Mamm., vol. 1, p. 523, 1800.

[5] Shaw, loc. cit., p. 524.

[6] Shaw, loc. cit., p. 531.

[7] Shaw, loc. cit., p. 532.

[8] Schinz, H. R., Cuvier's Thierreich, vol. 1, p. 191, 1821.

Condylura macroura Harlan[1] and *Astromycter prasinatus* Harris.[2] Both Harlan and Harris based their descriptions upon animals whose tails were in the enlarged winter condition. Harris was further deceived by his specimen being discolored with a shade of green, and proposed the new genus *Astromycter* to include this animal, though later[3] he returned it to the genus *Condylura*.

It is to be remarked that *Condylura cristata* has comparatively little geographic variation over a wide zonal range; specimens from the Lower Austral Zone, in Georgia and Virginia, are subspecifically inseparable from those from the Boreal Zone in Quebec and Labrador. A very slight increase in size is noticeable toward the northern part of the range of the species, but it is inconstant, and insufficient for subspecific recognition. Occasional local variations appear, but when a large series is examined from any one locality these prove inconstant, or else crop out in remote localities. Thus, in a series from Digby, Nova Scotia, the skulls have on the average very slightly higher braincases and more abruptly sloping frontals, but the difference is not constant and can be matched perfectly by specimens from New York, Massachusetts, Pennsylvania, and Maryland; the same is true of a small postpalatal process present in the majority of skulls in the series from Digby. A specimen from Marlow, Georgia, is an alcoholic from which the broken and imperfect skull has been removed for study; it offers no characters by which it can be separated from typical specimens from Pennsylvania. Possibly when larger series of adult specimens are available differences of diagnostic value not now discernible will become apparent.

The limits of the geographic range of *Condylura* are not satisfactorily known. Many published records of the star-nosed mole have certainly been based upon erroneous identifications. For example, the species is included among the mammals supposed to occur in Oklahoma,[4] and Townsend[5] lists it from "the Territory of the Oregon."

Richardson[6] describes a specimen said to have been taken by Douglas on the "banks of the Columbia." Richardson's description clearly indicates that the animal he had in hand was *Condylura cristata*, but it is almost certain that it was not collected near the banks of the Columbia River. The most westerly known point of the range of the species is in Manitoba, where, according to Seton,[7] specimens have been brought to the taxidermist shop of W. R. Hine in Winnipeg. Cory[1] records a specimen from Warsaw, Ill., and Professor Frank Smith, of the University of Illinois, found a dead specimen in the vicinity of Urbana in the same State.[2]

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[1] Harlan, R., Fauna Amer., p. 39, 1825.

[2] Harris, T. W., Amer. Journ. Sci. and Arts, vol. 9, p. 400, June, 1825.

[3] Harris, T. W., Boston Journ. Philos. and Arts, vol. 2, p. 582, July, 1825.

[4] Woodhouse, S. W., Report of an Expedition Down the Zuni and Colorado Rivers, by Capt. L. Sitgreaves; Mammals, p. 43, 1854.

[5] Under the names *Condylura longicaudata* and *Condylura macroura*. Townsend, J. K., Narrative of Journey across the Rocky Mountains to the Columbia River, p. 313, 1839.

[6] Under the name *Condylura macroura*. Richardson, J., Fauna Boreali-Amer., vol. 1, p. 284, 1829.

[7] Seton, Ernest Thompson, Life-Histories of Northern Animals, vol. 2, p. 1137, 1909.

Specimens examined.—Total number 218, as follows:

Connecticut: East Hartford, 1; Liberty Hill, 1;[3] Norfolk, 1.

District of Columbia: Washington, 10.

Georgia: Marlow, 1.

Labrador: Black Bay, 1;[3] Hamilton Inlet, 2; Paradise, 2; Saint Michael Bay, 1; Sandwich Bay, 2.

Maine: Eastport, 1; Freeport, 1; Oakland, 1; Penobscot River (East Branch), 2; Small Point, 2.

Maryland: Brookeville, 1; Cabin John, 1; Chevy Chase, 1; College Park, 2; Glendale, 1; Laurel, 2; Marshall Hall, 1; Prince Georges County, 1; Williamsport, 1; Woodside, 2.

Massachusetts: Belmont, 4;[3] Gardner, 1; Lunenburg, 4; Medway, 1;[3] Middleboro, 2; New Bedford, 1; Newburyport, 2; Seehonk, 1;[4] Watertown, 2;[3] Williamstown, 1; Wilmington, 4.

Michigan: Ann Arbor, 8;[5] Chelsea, 1;[5] Douglas Lake, 1;[5] Geddes, 1;[5] Gogebic, 1;[6] Hancock, 1;[5] Kalamazoo County, 1;[5] Muskegon County, 1; Porcupine Mountains, 2;[5] Portage Lake, 6.[5]

Minnesota: Elk River, 1; Fort Ripley, 1; Margie, 1.

New Brunswick: Arthurette, 1;[7] Hampton, 1.

New Hampshire: Ossipee, 4; Webster.[3]

New Jersey: Lake Hopatcong, 5;[4] Tuckahoe, 1.[4]

New York: Cross River, 1; Essex County, 1; Geneva, 2; Highland Falls, 2;[7] Ithaca, 1;[8] Lake George, 2; Lansing, 2;[6,9] Lockport, 1; Locust Grove, 11; Lyons Falls, 1; New York, 2; Nichols, 1; Oswego, 1;[9] Pelham, 1; Peterboro, 5; Rockland, 1;[7] Saint Lawrence County, 1; Sing Sing, 3.

North Carolina: Magnetic City, 2; Weaverville, 1.[3]

Nova Scotia: Barrington Passage, 1;[10] Digby, 18; Halifax, 7; James River, 1;[3] Newport, 2.[7]

Ohio: Cleveland, 1; Ellsworth, 1; Garrettsville, 3.

Ontario: Landsowne, 1;[7] Middlesex County, 1;[10] Moose Factory, 1; Muskoka, 1;[7] Ottawa, 4.

Pennsylvania: Carlisle, 1; Lake Leigh, 1;[4] Meadville, 2; New Lexington, 2;[4,11] Philadelphia, 1;[4] Radnor, 1.[4]

Quebec: East Main River, 1;[11] Godbout, 3; Lake Edward, 1;[3] Montreal, 1.

Vermont: East Wallingford, 4;[12] Mount Mansfield, 2; Rutland, 1.[13]

Virginia: Dismal Swamp, 4.

Wisconsin: Colby, 1; Medford, 2;[6] Merrill, 1;[6] Newald, Forest County, 1.[6]

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[1] Cory, C. B., Field Mus. Nat. Hist., publ. 153, zool. series 11, p. 444, 1912. In a personal letter dated March 20, 1914, Mr. Cory writes in regard to this specimen: "On a number of occasions Mr. Charles K. Worthen sent me boxes of birds and mammals, from which I could select specimens I desired and send back the others. One lot contained a specimen of *Condylura cristata* simply labeled 'Warsaw' (in pencil) with no other data. The specimen was returned to him."

[2] Wood, F. E., Bul. Illinois State Lab. Nat. Hist., vol. 8, p. 588, 1910.

[3] Collection Mus. Comp. Zool., Harvard College.

[4] Collection Acad. Nat. Sci. Philadelphia.

[5] Collection Univ. Michigan Mus.

[6] Collection Milwaukee Public Mus.

[7] Collection Amer. Mus. Nat. Hist.

[8] Collection of Hartley H. T. Jackson.

[9] Collection Field Mus. Nat. Hist.

[10] Collection Victoria Mem. Mus.

[11] Collection Carnegie Mus.

[12] Collection of D. E. Kent, Rutland, Vt.

[13] Collection of G. L. Kirk, Rutland, Vt.

Genus NEÜROTRICHUS Günther.

Neürotrichus Günther, Proc. Zool. Soc. London, 1880, p. 441, October, 1880.
Nëurotrichus Günther, Proc. Zool. Soc. London, 1880, plate 42, October, 1880.
Neurotrichus Forbes, Zool. Record, vol. 17, Mammalia, p. 14, 1881.
Neourotrichus Rye, Zool. Record, vol. 17, Index, p. 8, 1881.

Type species.—*Urotrichus gibbsii* Baird.

Geographic range.—Pacific coast region of North America west of the Cascades and Sierra Nevada, from southwestern British Columbia (Fraser River region) south to Fremont Peak, Monterey County, California (fig. 23).

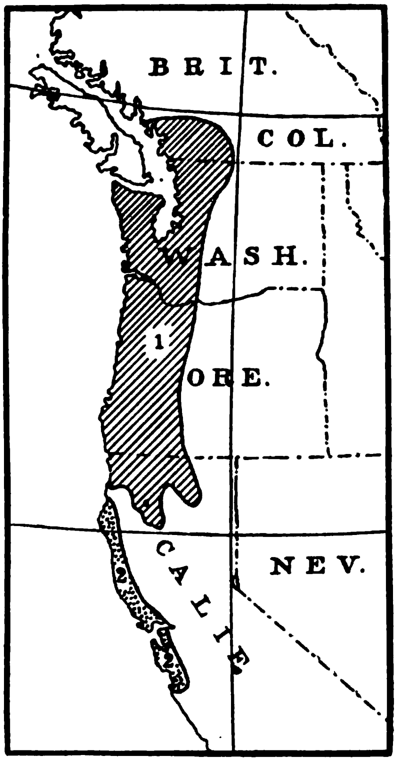

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FIG. 23.—Geographic range of the subspecies of *Neürotrichus gibbsii*. 1. *N. g. gibbsii*. 2. *N. g. hyacinthinus*.

External characters.—Smallest of the American Talpidæ; body somewhat robust, not much depressed. Tail moderate in length (about half as long as head and body), moderately fleshy, constricted at base, scaled, very distinctly annulated, sparsely covered with coarse hairs (fig. 24). Head conoidal, relatively long, not much depressed. Snout elongate, terminating in a naked disk or pad, apical superior surface naked to line of anterior edge of nasals; nostrils lateral in terminal pad, slightly crescentic, with anterior end of crescent enlarged and its concavity upward (fig. 25). Eyes minute (relatively about as in *Condylura*), concealed in the fur. Auricular opening large. Legs short, weak (relatively as in *Condylura*). Feet large, not fleshy, scaled, sparsely haired above, naked below. Fore feet hardly handlike, the palms longer than broad, toes relatively long. Fore claws relatively long, not broad, not depressed (fig. 26). Hind feet long and narrow, broader distally than proximally; six tubercles (varying slightly in position) on each hind foot, usually located one at base of third digit, one interdigital between the third and fourth digits, one between the fourth and fifth digits, one postero-interdigital between the second and third digits, and two near the center of the sole. Hind claws moderately long and slender, slightly compressed laterally, acute (fig. 27). Toes not webbed. Pelage similar in general to that of *Condylura*, but shorter, finer, and with underfur less clearly defined. Mammæ, 8: latero-pectoral, 2–2; latero-abdominal, 1–1; inguinal, 1–1.

Skeletal characters.—Clavicle relatively long and narrow (for the Talpidæ), length about twice the breadth; concave superiorly, inferior surface with a flat process projecting postero-laterally; not penetrated by a foramen. Humerus about three-fifths as broad as long, weaker medially (as in *Condylura*). Pelvis narrow, bones of opposite sides separated by considerable space (about 2 mm.) under acetabula; no osseous bridges connecting sacral vertebræ with ischium. Superior surface of last sacral vertebra without process. Os falciforme rudimentary and scarcely perceptible.

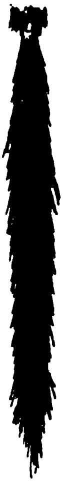

Fig. 24.—Tail of *Neŭrotrichus gibbsii hyacinthinus* (X1½). No. 160898, U. S. Nat. Mus., Biological Survey collection; from Aptos, Cal.

Skull conoidal, moderately depressed, without prominent processes and ridges, with moderately broad braincase, scarcely constricted interorbitally. Mastoids weak. Interparietal large, broad, irregularly semicircular, anteriorly deeply emarginate medially, posteriorly slightly emarginate and usually without a posterior median projection. Frontal region scarcely sloping ventro-anteriorly; frontal sinuses very slightly swollen. Rostrum moderately elongate; anterior ends of premaxillæ not much thickened, extending beyond nasals, forming a somewhat truncate notch anterior to the nasals. Anterior nares opening forward. Zygomata short, narrow, slightly out-curved, directed slightly downward anteriorly, the posterior end forward on squamosal (less so than in *Condylura*). Foramen magnum elliptical, relatively large. Infraorbital foramen large, the plate forming its outer wall relatively broad and heavy. Audital bullæ incomplete; no auditory meatus. External pterygoid region scarcely inflated (relatively more than in *Condylura*). Mesopterygoid space moderately long and broad, the sides usually gently concave. Palate moderately elongate, relatively narrow, terminating opposite posterior border of last molar; posterior border of palate slightly emarginate, without spine or notch. Anterior palatine foramina moderate, oval; first pair of posterior palatine foramina moderate, oval to elliptical-oval; second pair minute. Horizontal ramus of mandible slender, nearly straight; coronoid relatively long, erect proximally, curving posteriorly distally into an acute process; angle of mandible relatively short and narrow (smaller than coronoid); inferior mandibular notch relatively shallow and broad.

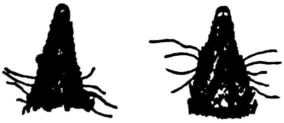

Fig. 25.—Snout of *Neŭrotrichus gibbsii gibbsii* (X1½). No. 83468, U. S. Nat. Mus.; from British Columbia.

Dental characters.—First upper incisors very short, relatively broad; second and third small (about half as large as first incisor), somewhat laterally compressed. Upper canine larger than third incisor, triangular, compressed, two-rooted, with a small postero-basal accessory cusp. First upper premolar similar to canine, slightly smaller; second upper premolar large, triangular, with a postero-basal cusp, a postero-internal basal cusplike heel, and sometimes with an anterior cusplike process on the cingulum, which tends to disappear with age. Upper molars W-shaped in transverse section, with an interior basal shelf having a distinctly bicuspidate edge; first and second molars subequal, the third much smaller.

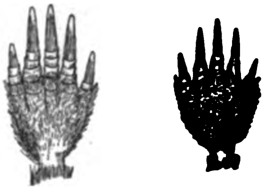

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FIG. 26.—Fore foot of *N. g. gibbsii* (X1½). Individual referred to in fig. 24.

First lower incisor small, spatulate, directed slightly antero-interiorly; second and third lower incisors and lower canine similar to first incisor, smaller, successively decreasing in size posteriorly, directed obliquely anteriorly, the canine with a smaller posterior basal tubercle. Lower premolars triangular, each with a posterior cusplike heel and an indistinct posterior median sulcus, the second about twice as large as first and with a small antero-basal tubercle. Lower molars M-shaped in transverse section, slightly compressed laterally (less so than in *Condylura*); interior shelf low and narrow, tricuspidate, the median cusp not bifid; first molar with minute basal tubercle between posterior and median interior cusps; first and second molars subequal, the third smaller. Dentition: i. $\frac{3}{3}$; c. $\frac{1}{1}$; pm. $\frac{2}{2}$; m. $\frac{3}{3}$; total 36.

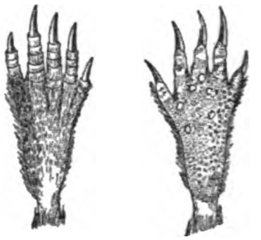

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FIG. 27.—Hind foot of *N. g. gibbsii* (X 1½). Individual referred to in fig. 24.

Key to Subspecies of Neürotrichus.

*a.*¹ Size smaller; color paler; length of skull less than 23.2 mm., *Neürotrichus gibbsii gibbsii* (p. 94).

*a.*² Size larger; color darker; length of skull more than 23.2 mm., *Neürotrichus gibbsii hyacinthinus* (p. 97).

Descriptions of species and subspecies of Neürotrichus.

NEÜROTRICHUS GIBBSII GIBBSII (Baird).

GIBBS'S MOLE.

(Pl. VI, figs. 1, 1a, 1b, 22.)

Urotrichus gibbsii Baird, Report Pacific R. R. Survey, vol. 8, part 1, Mammals, p. 76, 1857.

Urotrichus Gibsii Lord, Naturalist in Vancouver Island and British Columbia, p. 338, 1866.

Nëurotrichus (sic) *gibbsii* Günther, Proc. Zool. Soc. London, 1880, pl. 42, October, 1880.
Neürotrichus gibbsii True, Proc. U. S. Nat. Mus., vol. 7, p. 607, 1885.
Neurotrichus gibbsii Bryant, Zoe, vol. 1, p. 359, February, 1891.
Neurotrichus gibbsi Merriam, Mazama, vol. 1, p. 228, 1897.
Neurotrichus gibbsi major Merriam, N. Am. Fauna No. 16, p. 88, October 28, 1899.
  Type locality, Carberry Ranch, altitude 4100 feet, between Mount Shasta and Mount Lassen, Shasta County, California.
Neürotrichus gibbsii gibbsii Miller, U. S. Nat. Mus., Bul. 79, p. 11, December 31, 1912.
Neürotrichus gibbsii major Miller, U. S. Nat. Mus., Bul. 79, p. 11, December 31, 1912.

Type locality.—White River Pass, north of Mount Rainier, Pierce County, Washington.

Type specimen.—No. $\frac{662}{1843}$, U. S. Nat. Mus.; immature, sex unknown; poorly made skin and fragmentary skull; collected July 15, 1854, by George Gibbs.

Geographic range.—Extreme southwestern British Columbia, western Washington and Oregon west of the Cascade Mountains, south in the coast region to Eureka, Humboldt County, Cal., and in the interior, west of the Sierra Nevada, to South Yolla Bolly Mountain, Cal.

General characters.—Size small (total length averaging less than 120 mm.); color dark, usually dark mouse gray; tail medium in size (about one-third of total length), scaled in transverse annular rows, covered with a few blackish, coarse hairs; skull small (greatest length usually less than 23 mm.), flat, and not angular.

Color.—General tone dark mouse gray to blackish mouse gray, occasionally dusky neutral gray; upperparts and underparts essentially the same color, the underparts rarely slightly paler than the back; the longer hairs in full pelage frequently tipped with whitish, producing a frosted appearance; recently killed animals and specimens little handled generally show purplish and greenish iridescence. The worn pelage is paler and more brownish than the fresh.

Skull.—Small (greatest length usually less than 23 mm.), smooth, flat, not much depressed postorbitally, not much constricted interorbitally; frontal sinuses slightly swollen; zygomata short, weak; pterygoids short, weak, laterally flattened; audital bullæ incomplete; rostrum moderate in length and width; dentition moderate; first upper incisors flat and rodentlike; upper canine (third lateral tooth) flattened laterally, much like first upper premolar; anterior portion of cingulum of second upper premolar *not* usually developed into a superior cusplike process.

Measurements.—Average of 9 adult males from Sumas, British Columbia: Total length, 113 (107–117); tail vertebræ, 37.1 (34–39); hind foot, 16.6 (15.7–17). Average of 5 adult females from Sumas, British Columbia: 116.6 (111–120); 36.4 (33–40); 17 (17–17). Average of 3 males from Carberry Ranch (type locality of *N. g. major*), Shasta County, Cal.: 119.7 (118–121); 40.3 (39–42); 17 (17–17). *Skull:* Average of 10 skulls of adult males from Sumas, British Columbia: Greatest length, 22.5 (22.1–23); palatilar length, 9.4 (9.1–9.6);

mastoidal breadth, 10.3 (10.1–10.5); interorbital breadth, 5.3 (5.2–5.4); maxillary tooth row, 7.1 (7–7.2); mandibular molar-premolar row, 7.3 (7.1–7.5). Average of 6 skulls of adult females from Sumas, British Columbia: Greatest length, 22.4 (21.5–23); palatilar length, 9.4 (9.2–9.5); mastoidal breadth, 10.2 (9.6–10.5); interorbital breadth, 5.3 (5.1–5.5); maxillary tooth row, 7.1 (6.9–7.2); mandibular molar-premolar row, 7.2 (7–7.3). Average of 2 skulls of males from Carberry Ranch (type locality of *major*), Shasta County, Cal.: Greatest length, 22.7 (22.4–23); palatilar length, 9.3 (9.3–9.3); mastoidal breadth, 10.6 (10.5–10.7); interorbital breadth, 5.4 (5.4–5.4); maxillary tooth row, 7 (6.9–7); mandibular molar-premolar row, 7 (6.9–7.1).

Remarks.—This little mole, the most shrewlike of the American members of the family, shows comparatively little geographic variation throughout its rather extensive range; in fact, the local almost obscures the geographic variation. Southward a tendency appears toward an increase in size and toward the development of a cusplike process upon the anterior portion of the cingulum of the second upper premolar; this reaches the climax in *N. g. hyacinthinus.* The presence of this cusplike process on the second upper premolar, however, is not strictly diagnostic since it occasionally crops out, slightly developed, in specimens taken near the northern limit of the range of *N. g. gibbsii,* or may be absent in specimens of *hyacinthinus* taken near the southern border of its range. Thus, it occurs, weakly developed, in a few specimens from Sumas, British Columbia; it is absent in two specimens from Crescent City, Cal., but is present in five young adults from Eureka, Cal., and in one from Goldbeach, Oreg.; some specimens of *hyacinthinus* from Cuddeback and Aptos, Cal., have the process, while others lack it.

The form *Neurotrichus gibbsi major* Merriam [1] is here placed in synonymy under *N. g. gibbsii.* The type of *major* was collected at Carberry Ranch, altitude 4100 feet, between Mount Shasta and Mount Lassen, Shasta County, Cal.; a careful comparison of the type, topotypes, and other specimens from the Shasta region, with a large number of specimens from Washington and British Columbia fails to show any differences between *major* and *gibbsii* worthy of subspecific recognition; specimens of *major* average very slightly larger than *gibbsii* and in some other respects appear to be intermediate in characters between *gibbsii* and *hyacinthinus,* but in size and general proportions of skull they are much nearer *gibbsii.* The presence of an anterior "cusp" on the cingulum of the second upper premolar in *major* is not of diagnostic value, as has been shown in the preceding paragraph, and at best can be considered only an approach toward *hyacinthinus;* nor does the second lower premolar differ essentially from that of *gibbsii,* since it can be matched almost perfectly in any large series of the genus *Neürotrichus* from any locality.

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[1] Merriam, C. Hart, N. Am. Fauna No. 16, p. 88, 1899.

Five specimens examined from Eureka, Cal., are hardly adult, but are provisionally referred to *gibbsii* on account of color and size of skull; when a larger series of specimens, with more adults, is available from this region, a change of decision may be necessary.

Specimens examined.—Total number, 146, as follows:

British Columbia: Chilliwack Valley, 6; Douglas, 1;[1] Howe Sound, 3; Langley, 1; Sumas, 72; Tammi Hy Creek (Chilliwack Valley), 1;[1] Thurstons, 2.[1]

California: Arcata, 1;[2] Beswick, 1; Carberry Ranch, Shasta County, 3; Crescent City, 2; Eureka, 5;[3] Hoopa Valley, 1; Mount Shasta, 4; Salmon Mountains (near Etna Mills), 1; South Yolla Bolly Mountain, 1;[2] Tower House, Shasta County, 2;[2] Trinidad, 3.[2]

Oregon: Anna Creek, Mount Mazama, 1; Astoria, 1; Crater Lake, 1; Elk Head, 1; Eugene, 1; Fort Klamath, 4; Goldbeach, 1;[3] McKenzie Bridge, 1; Multnomah Falls, 1; Salem, 1;[4] Seaside, 1; Siskiyou, 1; Vida, 2; Yaquina Bay, 3.

Washington: Kirkland, 1; Lake Cushman, 4; Mount Rainier, 2; Mount Vernon, 3; Neah Bay, 1; Seattle, 1; Steilacoom, 2; Tenino, 1; White River, Cascade Mountains (type locality), 1.

NEÜROTRICHUS GIBBSII HYACINTHINUS Bangs.

SOUTHERN GIBBS'S MOLE.

(Pl. VI, figs. 2, 2a, 2b, 23.)

Neürotrichus gibbsi hyacinthinus Bangs, Amer. Nat., vol. 31, p. 240, March, 1897.

Neurotrichus gibbsii hyacinthinus Miller & Rehn, Proc. Boston Soc. Nat. Hist., vol. 30, p. 254, December, 1901.

Neurotrichus gibbsi hyacinthinus Elliot, Field Columb. Mus., publ. 105, zool. series, vol. 6, p. 467, 1905.

Neürotrichus gibbsii hyacinthinus Miller, U. S. Nat. Mus., Bul. 79, p. 11, December 31, 1912.

Type locality.—Nicasio, Marin County, California.

Type specimen.—No. 1240, Mus. Comp. Zool., Harvard College, Bangs collection; ♀ adult, skin and skull; collected March 10, 1894, by C. A. Allen.

Geographic range.—Coast region of California from Cuddeback, Humboldt County, south to Fremont Peak, Monterey County.

General characters.—Larger than *N. g. gibbsii;* color usually slightly darker; skull larger, relatively wider through braincase and rostrum, with more angular mastoid region.

Color.—Much like that of *N. g. gibbsii* but averaging darker; usually blackish mouse gray or dusky neutral gray; often almost black, especially in fresh pelage; in full unworn pelage sometimes distinctly overcast with hoary, due to whitish tips of the longer hair; worn pelage paler and more brownish; purplish and greenish iridescence shows in fresh specimens, as in *gibbsii*.

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[1] Collection Victoria Mem. Mus.

[2] Collection Mus. Vert. Zool., Univ. California.

[3] Collection Field Mus. Nat. Hist.

[4] Collection Amer. Mus. Nat. Hist.

Skull.—Similar to that of *N. g. gibbsii* but larger (greatest length usually over 23.5 mm.) and relatively wider through braincase, interorbitally, and through rostrum; mastoid region usually heavier and more angular than in *gibbsii;* anterior portion of cingulum of second upper premolar usually developed into a superior cusplike process.

Measurements.—Average of 6 males from Aptos, Santa Cruz County, Cal.: Total length, 121.5 (118–126); tail vertebræ, 38.3 (37–39); hind foot, 16.9 (16.5–17). *Skull:* Young adult male from type locality: Greatest length, 24.2; palatilar length, 9.8; mastoidal breadth, 11; interorbital breadth, 5.7; maxillary tooth row, 7.4; mandibular molar-premolar row, 7.3. Skull of young adult female from type locality: Greatest length, 23.5; palatilar length, 9.6; mastoidal breadth, 10.6; interorbital breadth, 5.4; maxillary tooth row, 7.3; mandibular molar-premolar row, 7.3. Average of 6 skulls of males from Aptos, Santa Cruz County, Cal.: Greatest length, 23.8 (23–24); palatilar length, 9.9 (9.6–10); mastoidal breadth, 10.9 (10.7–11.1); interorbital breadth, 5.6 (5.5–5.7); maxillary tooth row 7.6 (7.4–7.8); mandibular molar-premolar row, 7.6 (7.5–7.7).

Remarks.—The southern-coast form of Gibbs's mole, *N. g. hyacinthinus,* differs from the typical northern form, *N. g. gibbsii,* chiefly in its larger size and darker color, though frequently specimens are no darker than typical *gibbsii*. Specimens from the south of San Francisco Bay are not quite so intensely colored as those from the type region, and, on the average, seem to have slightly shorter rostra, but the differences are too trivial for subspecific designation.

Specimens examined.—Total number, 58, as follows:

California: Aptos, 10; Burlingame, 1; Cazadero, 1;[1] Cuddeback, 7;[1] Fairfax, 1;[1] Freestone, 1;[1] Fremont Peak, 1; Gualala, 9; Guerneville, 3;[1] Inverness, 4;[1] Mendocino, 1;[1] Nicasio (type locality), 6; Palo Alto, 1;[2] Point Arena, 4;[1] San Geronimo, 1;[1] Santa Cruz, 7.

PLATE I.

[Natural size.]

FIG. 1. Early stage in molting process of *Scalopus aquaticus aquaticus* (Linnæus); ♀ adult; Fort Myer, Va., April 15, 1897. (No. 83686, U. S. Nat. Mus.)

2. Middle stage in molting process of *Scalopus aquaticus aquaticus* (Linnæus); ♀ adult; Falls Church, Va., May 26, 1907. (No. 144453, U. S. Nat. Mus.)

3. Nestling young of *Scalopus aquaticus howelli* Jackson; Jackson, N. C. (No. 7250, U. S. Nat. Mus.)

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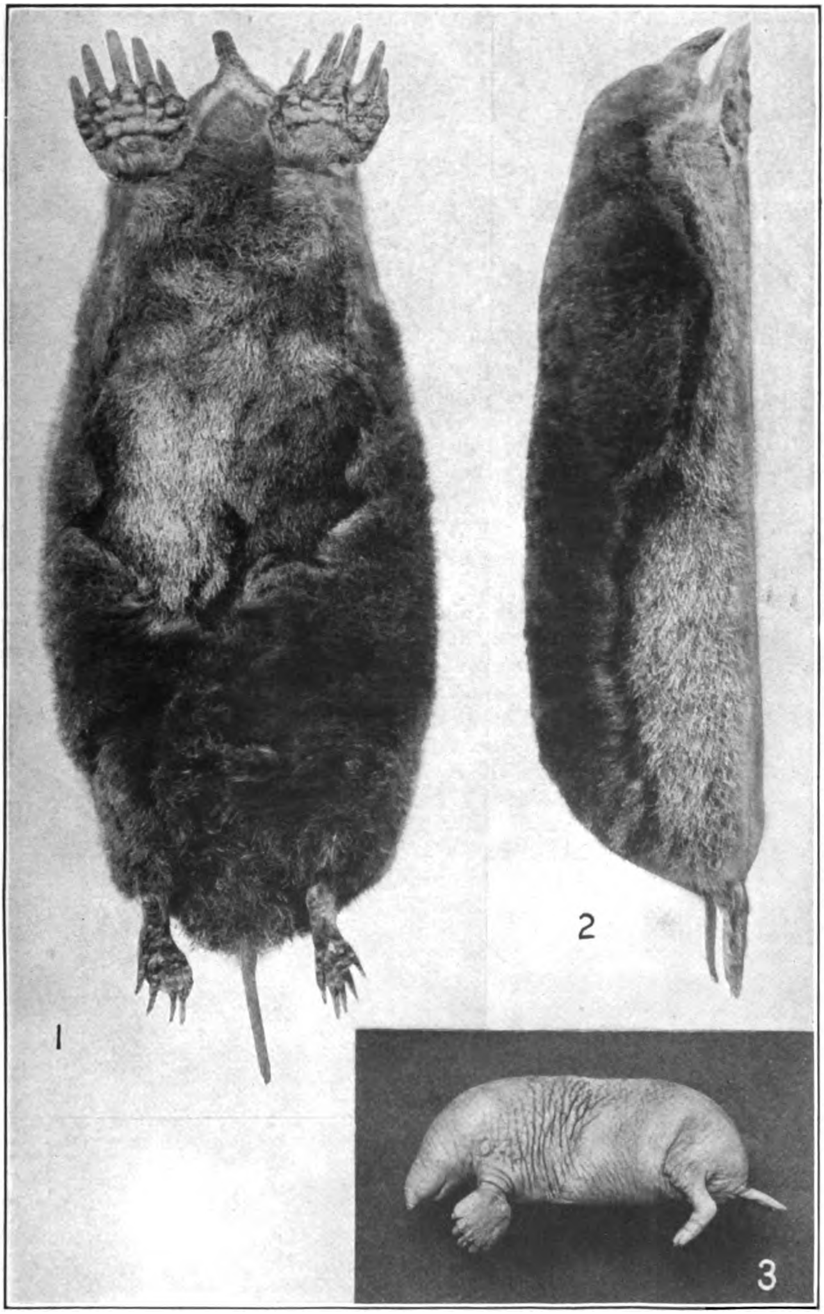
[1] Collection Mus. Vert. Zool., Univ. California.

[2] Collection Field Mus. Nat. Hist.



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MOLTING AND YOUNG OF SCALOPUS.

1, 2. Scalopus aquaticus aquaticus.
3. Scalopus aquaticus howelli.

PLATE II.

[Natural size.]

FIG. 1. *Scalopus aquaticus aquaticus* (Linnæus); essentially a topotype; ♂ adult; near Media, Pa. (No. 9845, Acad. Nat. Sci. Philadelphia; 2845, Rhoads collection.)

2. *Scalopus aquaticus howelli* Jackson; type; ♂ adult; Autaugaville, Ala. (No. 177931, U. S. Nat. Mus., Biological Survey collection.)

3. *Scalopus aquaticus australis* (Chapman); topotype; ♂ adult; Gainesville, Fla. (No. 7783, Field Mus. Nat. Hist.)

4. *Scalopus aquaticus anastasæ* (Bangs); topotype; ♂ adult; Point Romo, Anastasia Island, Fla. (No. 7193, Mus. Comp. Zool., Harvard College, Bangs collection.)

5. *Scalopus aquaticus parvus* (Rhoads); ♂ adult; Port Tampa City, Fla. (No. 7202, Mus. Comp. Zool., Harvard College, Bangs collection.)

6. *Scalopus aquaticus machrinus* (Rafinesque); ♂ adult; Oakwoods Cemetery, Chicago, Ill. (No. 8155, Field Mus. Nat. Hist.)

7. *Scalopus aquaticus machrinoides* Jackson; type; ♂ adult; Manhattan, Kans. (No. 169717, U. S. Nat. Mus., Biological Survey collection.)

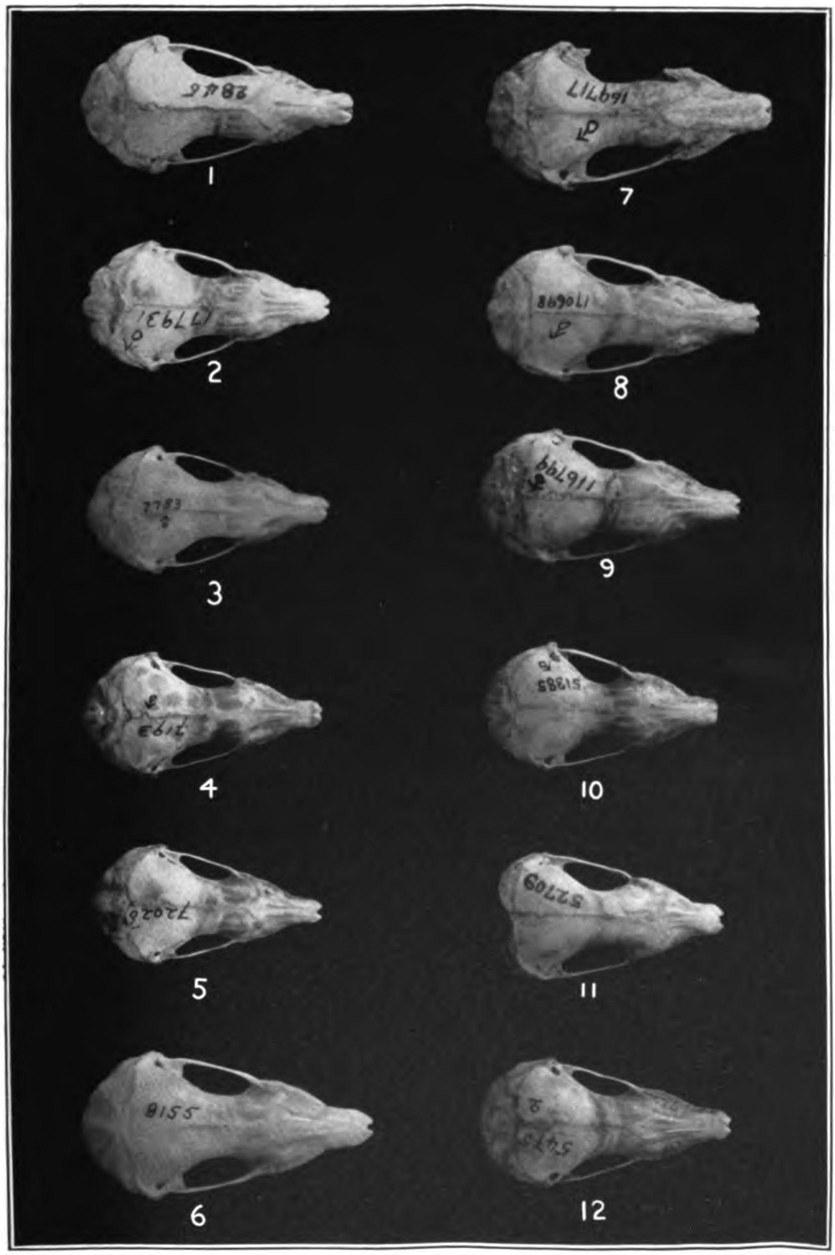
8. *Scalopus aquaticus pulcher* Jackson; type; ♂ adult; Delight, Ark. (No. 170698, U. S. Nat. Mus., Biological Survey collection.)

9. *Scalopus aquaticus caryi* Jackson; type; ♂ young adult; Neligh, Nebr. (No. 116799, U. S. Nat. Mus., Biological Survey collection.)

10. *Scalopus aquaticus texanus* (Allen); topotype; ♂ adult; Rockport, Tex. (No. 51385, U. S. Nat. Mus., Biological Survey collection.)

11. *Scalopus inflatus* Jackson; type; young adult, sex unknown; State of Tamaulipas, Mexico (45 miles from Brownsville, Tex.). (No. 52709, U. S. Nat. Mus., Biological Survey collection.)

12. *Scalopus æreus* (Bangs); type; ♀ adult; Stilwell, Okla. (No. 5475, Mus. Comp. Zool., Harvard College, Bangs collection.)



B2002-103

SKULLS OF SCALOPUS AQUATICUS (SUBSPP.), S. INFLATUS, AND S. ÆREUS.

1. S. a. aquaticus.
2. S. a. howelli.
3. S. a. australis.
4. S. a. anastasæ.
5. S. a. parvus.
6. S. a. machrinus.
7. S. a. machrinoides.
8. S. a. pulcher.
9. S. a. caryi.
10. S. a. texanus.
11. S. inflatus.
12. S. æreus.

PLATE III.

[Natural size.]

FIGS. 1, 1a. *Scalopus aquaticus aquaticus* (Linnæus); essentially a topotype; ♂ adult; near Media, Pa. (No. 9845, Acad. Nat. Sci. Philadelphia; 2845, Rhoads collection.)

2, 2a. *Scalopus aquaticus howelli* Jackson; type; ♂ adult; Autaugaville, Ala. (No. 177931, U. S. Nat. Mus., Biological Survey collection.)

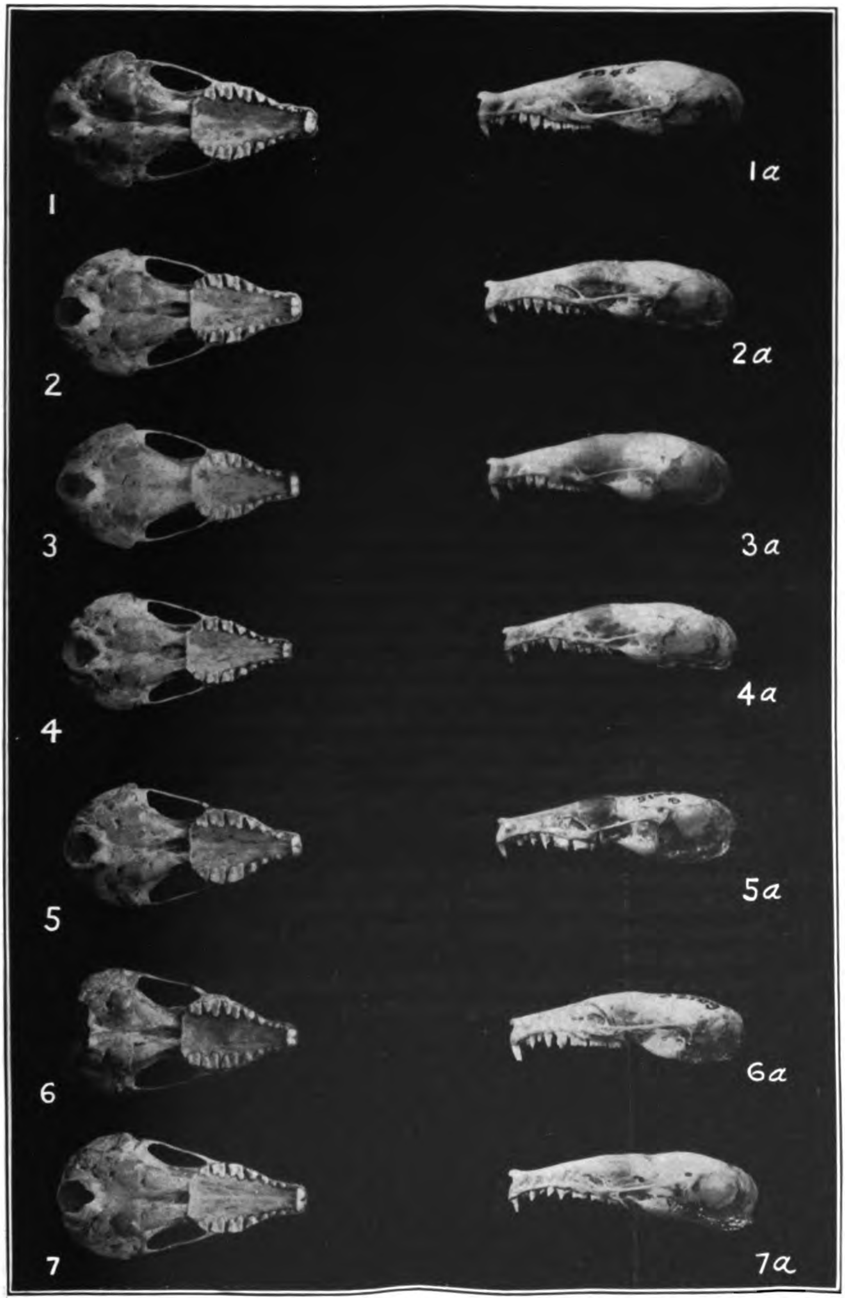
3, 3a. *Scalopus aquaticus australis* (Chapman); topotype; ♂ adult; Gainesville, Fla. (No. 7783, Field Mus. Nat. Hist.)

4, 4a. *Scalopus aquaticus parvus* (Rhoads); ♂ adult; Port Tampa City, Fla. (No. 7202, Mus. Comp. Zool., Harvard College, Bangs collection.)

5, 5a. *Scalopus aquaticus texanus* (Allen); topotype; ♂ adult; Rockport, Tex. (No. 51385, U. S. Nat. Mus., Biological Survey collection.)

6, 6a. *Scalopus inflatus* Jackson; type; young adult, sex unknown; State of Tamaulipas, Mexico (45 miles from Brownsville, Tex.). (No. 52709, U. S. Nat. Mus., Biological Survey collection.)

7, 7a. *Scalopus æreus* (Bangs); type; ♀ adult; Stilwell, Okla. (No. 5475, Mus. Comp. Zool., Harvard College, Bangs collection.)



B2003-103

SKULLS OF SCALOPUS AQUATICUS (SUBSPP.), S. INFLATUS, AND S. ÆREUS.

1, 1a. S. a. aquaticus.
2, 2a. S. a. howelli.
3, 3a. S. a. australis.
4, 4a. S. a. parvus.
5, 5a. S. a. texanus.
6, 6a. S. inflatus.
7, 7a. S. æreus.

PLATE IV.

[Natural size.]

FIG. 1. *Scapanus townsendii* (Bachman); ♂ adult; Ferndale, Humboldt County, Cal. (No. 19141, Mus. Vert. Zool., Univ. California.)

2. *Scapanus orarius orarius* True; ♂ adult; Ferndale, Humboldt County, Cal. (No. 19111, Mus. Vert. Zool., Univ. California.)

3. *Scapanus orarius schefferi* nobis; type; ♂ adult; Walla Walla, Wash. (No. 204997, U. S. Nat. Mus., Biological Survey collection.)

4. *Scapanus latimanus latimanus* (Bachman); ♂ adult; Menlo Park, San Mateo County, Cal. (No. 18779, Mus. Vert. Zool., Univ. California.)

5. *Scapanus latimanus occultus* Grinnell & Swarth; ♂ adult; San Gabriel, Cal. (No. 30310, U. S. Nat. Mus., Biological Survey collection.)

6. *Scapanus latimanus grinnelli* Jackson; type; ♂ young adult; Independence, Cal. (No. 17785, Mus. Vert. Zool., Univ. California.)

7. *Scapanus latimanus sericatus* Jackson; type; ♀ adult; Yosemite, Cal. (No. (109548, U. S. Nat. Mus., Biological Survey collection.)

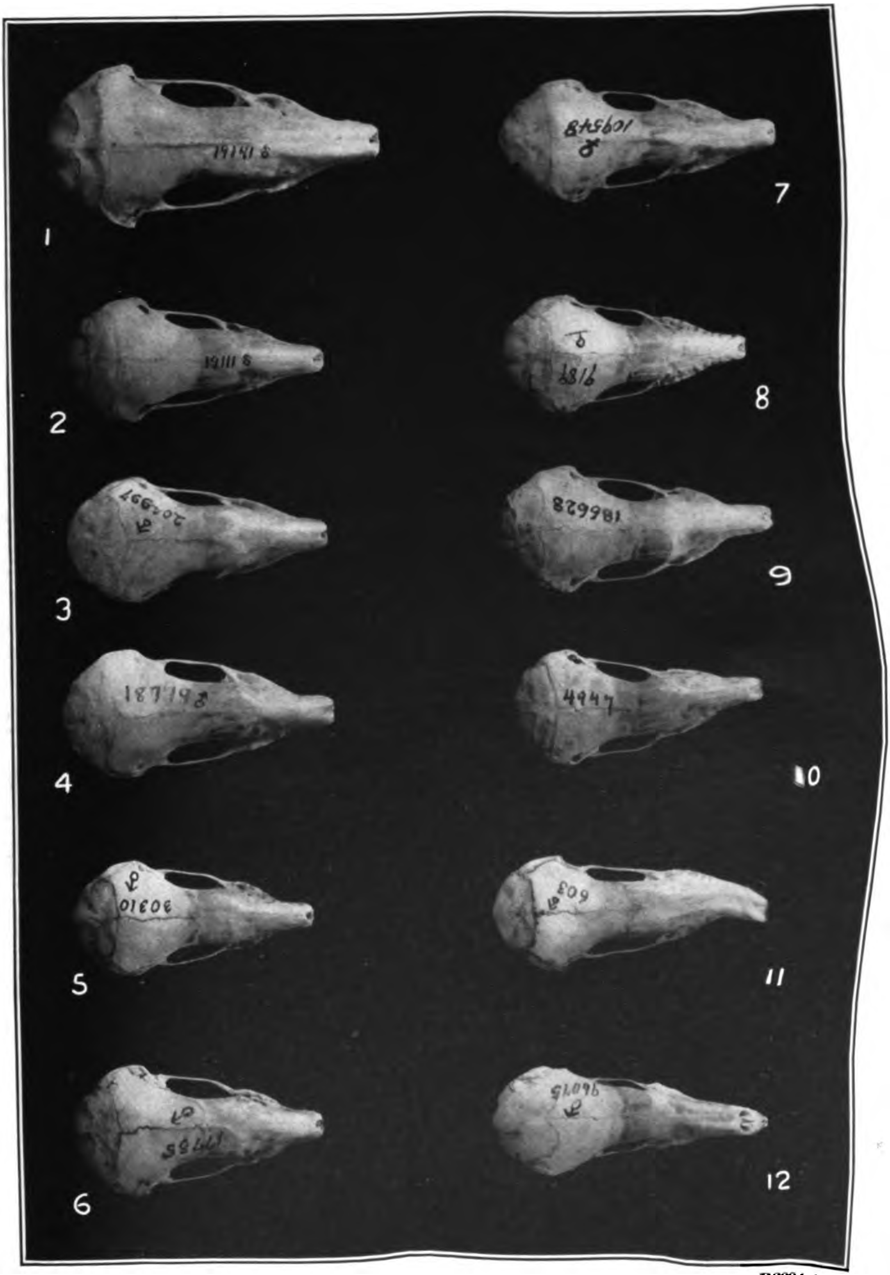
8. *Scapanus latimanus minusculus* Bangs; type; ♀ young adult; Fyffe, Cal. (No. 9189, Mus. Comp. Zool., Harvard College, Bangs collection.)

9. *Scapanus latimanus dilatus* True; type; young adult, sex unknown, probably ♂; Fort Klamath, Oreg. (No. 186628, U. S. Nat. Mus., Merriam collection.)

10. *Scapanus anthonyi* Allen; type; ♂ adult; San Pedro Martir Mountains, Lower California. (No. 4947, Amer. Mus. Nat. Hist.)

11. *Parascalops brewer i*(Bachman); ♂ young adult; Leasuresville, Pa. (No. 603, Carnegie Mus.)

12. *Condylura cristata* (Linnæus); ♂ adult; Lunenburg, Mass. (No. 96075, U. S. Nat. Mus., Biological Survey collection.)



B2004-103

SKULLS OF SCAPANUS, PARASCALOPS, AND CONDYLURA.

1. S. townsendii.
2. S. o. orarius.
3. S. o. schefferi.
4. S. l. latimanus.
5. S. l. occultus.
6. S. l. grinnelli.
7. S. l. sericatus.
8. S. l. minusculus.
9. S. l. dilatus.
10. S. anthonyi.
11. P. breweri.
12. C. cristata.

PLATE V.

[Natural size.]

FIGS. 1, 1a. *Scapanus townsendii* (Bachman); ♂ adult; Ferndale, Humboldt County Cal. (No. 19141, Mus. Vert. Zool., Univ. California.)

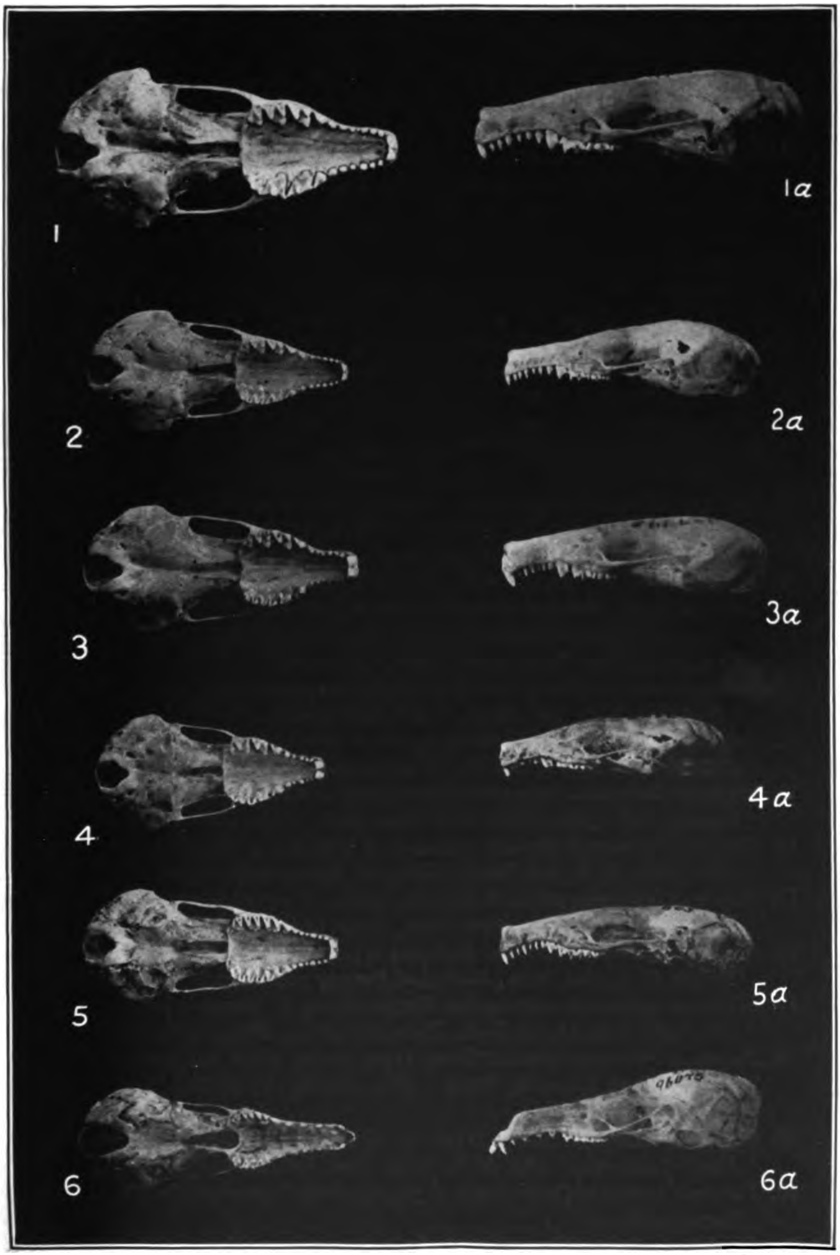
2, 2a. *Scapanus orarius orarius* True; ♂ adult; Ferndale, Humboldt County, Cal. (No. 19111, Mus. Vert. Zool., Univ. California.)

3, 3a. *Scapanus latimanus latimanus* (Bachman); ♂ adult; Menlo Park, San Mateo County, Cal. (No. 18779, Mus. Vert. Zool., Univ. California.)

4, 4a. *Scapanus anthonyi* Allen; type; ♂ adult; San Pedro Martir Mountains, Lower California. (No. 4947, Amer. Mus. Nat. Hist.)

5, 5a. *Parascalops breweri* (Bachman); ♂ young adult; Leasuresville, Pa. (No. 603, Carnegie Mus.)

6, 6a. *Condylura cristata* (Linnæus); ♂ adult; Lunenburg, Mass. (No. 96075, U. S. Nat. Mus., Biological Survey collection.)



B2005–103

SKULLS OF SCAPANUS, PARASCALOPS, AND CONDYLURA.

1, 1a. S. townsendii.
2, 2a. S. o. orarius.
3, 3a. S. l. latimanus.
4, 4a. S. anthonyi.
5, 5a. P. breweri.
6, 6a. C. cristata.

PLATE VI.

[Natural size.]

FIGS. 1, 1a, 1b, 22. *Neürotrichus gibbsii gibbsii* (Baird); ♂ adult; Sumas, British Columbia. (No. 62952, U. S. Nat. Mus.)

2, 2a, 2b, 23. *Neürotrichus gibbsii hyacinthinus* Bangs; ♂ young adult; Aptos, Cal. (No. 160900, U. S. Nat. Mus., Biological Survey collection.)

FIG. 3. *Scalopus aquaticus aquaticus* (Linnæus); essentially a topotype; ♂ adult; near Media, Pa. (No. 9845, Acad. Nat. Sci. Philadelphia; 2845, Rhoads collection.)

4. *Scalopus aquaticus howelli* Jackson; type; ♂ adult; Autaugaville, Ala. (No. 177931, U. S. Nat. Mus., Biological Survey collection.)

5. *Scalopus aquaticus australis* (Chapman); topotype; ♂ adult; Gainesville, Fla., (No. 7081, Mus. Comp. Zool., Harvard College, Bangs collection.)

6. *Scalopus aquaticus machrinus* (Rafinesque); ♂ adult; Oakwoods Cemetery, Chicago, Ill. (No. 8155, Field Mus. Nat. Hist.)

7. *Scalopus aquaticus texanus* (Allen); topotype; ♂ adult; Rockport, Tex. (No. 51385, U. S. Nat. Mus., Biological Survey collection.)

8. *Scalopus inflatus* Jackson; type; young adult, sex unknown; State of Tamaulipas, Mexico (45 miles from Brownsville, Tex.). (No. 52709, U. S. Nat. Mus., Biological Survey collection.)

9. *Scalopus æreus* (Bangs); type; ♀ adult; Stilwell, Okla. (No. 5475, Mus. Comp. Zool., Harvard College, Bangs collection.)

10. *Scapanus townsendii* (Bachman); ♂ adult; Ferndale, Humboldt County, Cal. (No. 19141, Mus. Vert. Zool., Univ. California.)

11. *Scapanus orarius orarius* True; ♂ adult; Ferndale, Humboldt County, Cal. (No. 19111, Mus. Vert. Zool., Univ. California.)

12. *Scapanus orarius schefferi* nobis; type; ♂ adult; Walla Walla, Wash. (No. 204997, U. S. Nat. Mus., Biological Survey collection.)

13. *Scapanus latimanus latimanus* (Bachman); ♂ adult; Menlo Park, San Mateo County, Cal. (No. 18779, Mus. Vert. Zool., Univ. California.)

14. *Scapanus latimanus occultus* Grinnell & Swarth; ♂ adult; Alhambra, Cal. (No. 30299, U. S. Nat. Mus., Biological Survey collection.)

15. *Scapanus latimanus grinnelli* Jackson; type; ♂ young adult; Independence, Cal. (No. 17785, Mus. Vert. Zool., Univ. California.)

16. *Scapanus latimanus sericatus* Jackson; type; ♀ adult; Yosemite, Cal. (No. 109548, U. S. Nat. Mus., Biological Survey collection.)

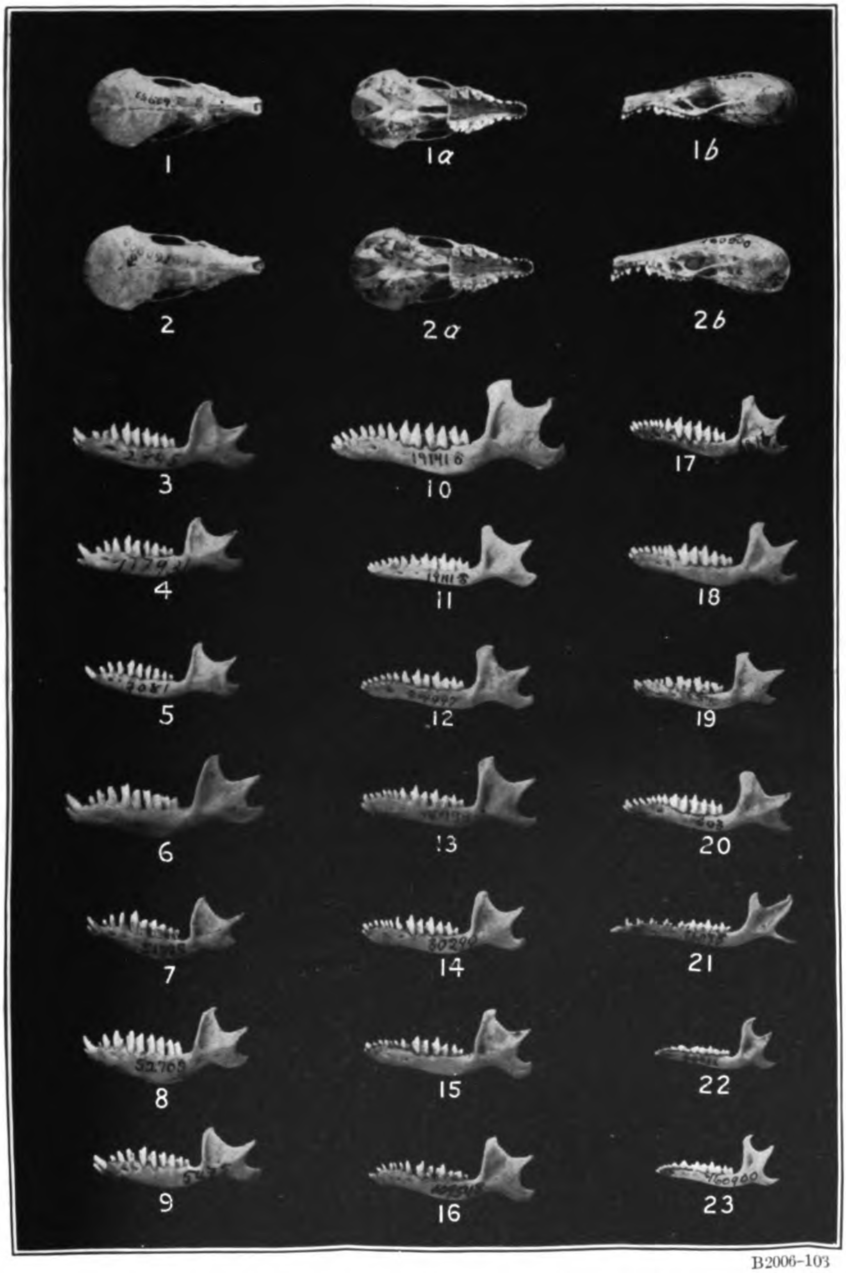
17. *Scapanus latimanus minusculus* Bangs; type; ♀ young adult; Fyffe, Cal. (No. 9189, Mus. Comp. Zool., Harvard College, Bangs collection.)

18. *Scapanus latimanus dilatus* True; type; young adult, sex unknown, probably ♂; Fort Klamath, Oreg. (No. 186628, U. S. Nat. Mus., Merriam collection.)

19. *Scapanus anthonyi* Allen; type; ♂ adult; San Pedro Martir Mountains, Lower California. (No. 4947, Amer. Mus. Nat. Hist.)

20. *Parascalops breweri* (Bachman); ♂ young adult; Leasuresville, Pa. (No. 603, Carnegie Mus.)

21. *Condylura cristata* (Linnæus); ♂ adult; Lunenburg, Mass. (No. 96075, U. S. Nat. Mus., Biological Survey collection.)



B2006-103

SKULLS OF NEÜROTRICHUS, AND MANDIBLES OF AMERICAN TALPIDÆ.

1, 1a, 1b, 22. N. g. gibbsii.
2, 2a, 2b, 23. N. g. hyacinthinus.
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4. Scalopus a. howelli.
5. Scalopus a. australis.
6. Scalopus a. machrinus.
7. Scalopus a. texanus.
8. Scalopus inflatus.
9. Scalopus æreus.
10. Scapanus townsendii.
11. Scapanus o. orarius.
12. Scapanus o. schefferi.
13. Scapanus l. latimanus.
14. Scapanus l. occultus.
15. Scapanus l. grinnelli.
16. Scapanus l. sericatus.
17. Scapanus l. minusculus.
18. Scapanus l. dilatus.
19. Scapanus anthonyi.
20. Parascalops breweri.
21. Condylura cristata.

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